THE

PRACTICAL TEACHER:

A Monthly Educational Journal.

EDITED BY JOSEPH HUGHES.

'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'
COWPER—THE TASK, VI., 96, 97.

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Health at School.

No. I.—INTRODUCTORY.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),

President of the Council of the British Medical Association.

THE Hygiene of School Life, or as it is called in common parlance, 'Health at School,' is of paramount importance in connection with the subject of Political Economy and the prosperity of the nation. It must be taken into consideration by all those who are in any way connected with the education of the young, and especially by the teacher himself. It is fully equal to that of the hygiene of the nursery. Its responsibilities are even greater: both have been very much neglected in the past by all classes of the community.

It is in the dawn of life that decided impressions are immediately made upon the ductile material of the human constitution which will make or mar the framework as well as the delicate machinery of the future man. Those impressions may lead him on to a life of happiness and health, or to one of unhappiness, which will be to some extent consequent upon the ill-health and low bodily vigour which insanitary surroundings may produce. If the impress is put on too heavily, the result may be disastrous. The form of the body itself; the shape of a limb; the development of an individual organ; the cultivation of a sense, may be each and all interfered with in the early days of childhood: the influence thus brought to bear may stamp its impress upon the child, and determine the result as to certain careers which it shall not follow. How many curved spines are due to wrong habits contracted in school! How many eyes have been deprived of their accommodating power by indulgence in positions which it is the teacher's duty to disallow! The error of the nurse or of the teacher may mar or even destroy the noblest work of God.

The damage which results from a misunderstanding or an ignorance of the first principles of the laws of health is manifested very clearly by statistical evidence so far as total loss is concerned, but it tells us very little of that partial mischief which so often follows from neglect of nature's laws. It is thoroughly well proved by repeated reports, that out of every 1000 children born into the world in populous districts, at least 150 depart this life before they have lived a twelvemonth. Yet is it not the birthright of every child that it should enjoy perfect health, and reach a good old age without being subjected to the influence of hereditary diseases? The passions and the ignorance of our forefathers still produce an influence, and at the present day lust and disease are daily robbing an immense multitude of that birthright which belongs to them. It is in diminishing the incidence of this mischief that 'Health at School' requires deep consideration. Nearly one-half of all the deaths which actually take place are those of children under five years of age. It would be waste of time to illustrate these statistical facts by reference to individual cases, but for the sake of example I may mention Birkenhead; the report for that township is now before me. For some years past, upwards of fifty per cent. of the deaths from all causes were those of children under five years of age. That is, one-half of the population never had the opportunity of going to an elementary school at all, for they 'were not' in existence at the age of five. The deaths of persons over sixty years of age were twelve per cent. only. Of late years, general hygienic measures have been adopted by the local authority in that locality. These measures have reduced the death-rate of young children to forty per cent. of the gross mortality, and have raised that of those above sixty years of age to twenty per cent. This result shows what may be done by corporate action when well directed; but no action taken by a local authority can reduce infant mortality to anything like a moderate standard unless there is at the same time an extension of hygienic knowledge among the masses; until parents and guardians know something of the first principles of sanitary laws, the reduction in infant mortality will not be great.

The bearing of these points upon 'Health at School' is shown in the fact, that it is sometimes asserted by intelligent people that this infant mortality is a good thing, that it weeds out from the masses the weak, the delicate, and the diseased, and leaves behind it the

stronger and better developed part of the population; that it eliminates the unhealthy, and is a benefit to the rest of mankind; and that it gives a teacher a better material to work upon: that there is a good side in the mortality among infants as well as a bad one.

This argument is an unsound one. If the effect of unhealthy states of the community were limited to those who die, there might be something said for it by the student in political economy, if we left out of the problem all reference to the morality of the result. It is certain that the unhealthy condition which leads to this great infant mortality tends at the same time to lay the foundation for mischief in a large portion of those who pass the age of five years. These fundamental stages will develop in an increasing ratio as time goes on, and the want of true sanitary knowledge in the nursery finds its practical demonstration in the production of manifest disease in the individual long after the nursery has been left and even the state of pupilage in elementary schools passed through. School life may bring this hidden diathesis into light sooner or later, according to the conditions under which that school life is carried on. It may bring out to the surface and expel it from the constitution on the one hand, or it may on the other hand fan it into activity and hasten its development into a very manifest disorder, or even into a fatal disease. This result will be brought about in one way or the other according to the correctness or otherwise of the principles upon which the surroundings of the school as to its sanitary condition have been laid down, and the customs which may be indulged in by the scholars or insisted upon by the teacher. There is something more in 'Health at School' than simply preventing the spread of epidemic or of enthetic disease. There is something more than meets the first thoughts which arise when we speak of the presence or absence of this or that form of epidemic, something which specially excites the dread of the teacher when the examinations of his scholars are about to commence. In addition to this there is a *minus* quantity in the matter which may or may not be great in the inhabitants of a particular district, but which will tell more or less upon the general health of every school, according to its surroundings and the customs which are followed within its walls. This *minus* quantity represents the depreciation in the general health which is certain to belong to some or all of the children, and will be the measure of their constitutional tendency to take on epidemic influences whenever they are presented to them either within or without the school buildings themselves. This minus quantity will be comparatively harmless in a properly arranged and well conducted school, but it becomes of serious importance in one in which insanitary surroundings and insanitary principles are allowed to be present; our duty therefore is not only to keep out all epidemic or infectious influences, but to raise the health tone of the whole body of scholars, so that this *minus* quantity may be gradually decreased and an approach made to a really healthy level. There therefore is an element to be considered which is altogether outside the question of infectious diseases, and yet is intimately mixed up with them. If this *minus* quantity in the matter of general health is considerable whenever the germs or exciting cause of infec- [illegible] epidemic disease find admission into a given [illegible] ey will manifest themselves with greater or [illegible] ity according as this *minus* quantity is considerable or otherwise. If no such germs or exciting causes of specific diseases are imported into a school at any particular time or season, yet its arrangements may be such as may prepare for the reception and propagation of an infectious malady elsewhere than within the school. The managers may have made every practicable arrangement for the exclusion of specific forms of disease, but they may be at the same time assisting to increase the *minus* quantity in the matter of general health and damaging the community, whilst they may be pointing all the time to the efficiency of their arrangements in excluding such diseases as scarlatina or diphtheria from among their scholars.

This element is altogether outside the so-called germ theory or the glandular theory as applied to epidemic or infectious diseases, and hitherto has not been at all considered upon its merits. Thus, although no germ of a particular disease or particle of morbid matter may be distributed by a given school, it may yet be the means by which the general debility of the neighbourhood may be increased. It may add to the number of deaths in a given district from tubercular diseases, simply because the foci of that particular form of malady which are to be found more or less in the constitutions of the children of all classes have been allowed to increase in quantity, by the want of good hygienic surroundings in the school-house and class-rooms. If the construction of the buildings and the principles pursued in the school had been carried out on sound foundations, different results would have arisen. These foci of disease, which are something like particles of ice in a stream, the surface of which has been reduced to a temperature slightly below the freezing-point, increase or decrease according as the *minus* quantity in the matter of general health rises or falls. If this *minus* quantity disappear, the foci of disease dwindle away, and may be at length so dwarfed as to be incompatible with any future growth. It is probable that these foci of tubercular disease are to be more or less found in nine-tenths of the younger portion of our population; and the duty of the school authority is not only to prevent the spread of infectious diseases among their scholars, but also to prevent the increase of this morbid matter which already exists in the frame of those submitted to their care. Taking one illustration for our consideration, and looking at the foci as if they were of microscopic particles of ice in a stream, the temperature of which stream rises or falls according to its surroundings; so school life adds to or diminishes the size and number of these foci in a given constitution, until they are enabled either to assert their individuality by collective action, or are so dwarfed and diminished as to altogether lose the influence which they were about to obtain. It should be thoroughly understood that the whole population of the country is more or less infected with morbid products. These have resulted from a long-continued disobedience to the first laws of health, either in relation to hygiene or to the general nutrition of the body. These tendencies are transmitted from parent to child just as much as other conditions which belong to race. It is more than probable that if the parentage of each child could be traced back to four generations, some one or more of the thirty persons to whom a particular child has been indebted for its existence would

be found to have been the subject of some disease capable of transmitting a hereditary taint. These taints may be classed under several heads. There is the tubercular, the syphilitic, the gouty, the rheumatic, and the cancerous taint. It is in the power of school hygiene to interfere with the development of these taints, to dwarf them by the arrangements of the school, to prevent their increase by the teachings of the master, and to oust them from the dominion they now hold upon the constitution of man. I am not about to assert that all these hereditary taints are to be removed by attention to 'Health at School.' At least one-half of the deaths which occur now-a-days is caused by diseases which are connected in their origin with the tubercular diathesis, and it is more especially with this taint that school hygiene has to grapple. The sanitary or insanitary condition of the school and its surroundings have in days gone by, and are even still adding to this. The tendency to tubercular disease is often fanned into activity by ill-directed school life, and just as it can be increased by wrong steps, so it can be diminished by right ones.

There is therefore much more in the question of 'Health at School' than is implied in its ordinarily accepted meaning, something more than arises from a consideration of the means to be taken to exclude the foci of infective diseases or to limit epidemic influences. We have to diminish in our raw material the germs of mischief which are already there; and just as we try by education to prevent the growth of evil mental passions, so we ought to try and prevent the growth of those germs of evil which are likely to undermine the health of the future men.

Our duty, therefore, is to dwarf these germs, to diminish the chances of their development after the child has left the school-house, as well as to prevent the intrusion of infectious agencies which are capable of spreading from child to child.

Anecdotal Natural History.

No. I.—THE SQUIRREL TRIBE.

BY REV. J. G. WOOD, M.A., F.L.S.,

Author of 'Homes without Hands,' 'Nature's Teachings,' etc.,

AND THEODORE WOOD,

Joint Author of 'The Field Naturalist's Handbook.'

ALMOST everybody is familiar with the common squirrel (*Sciurus Europæus*), that reddish-brown animal with the bushy tail which is so plentiful in nearly all our woods and forests, where it sometimes works considerable mischief. And even those people who have never been fortunate enough to see it in its native haunts, springing from tree to tree, and gambolling merrily among the branches, must have noticed the unfortunate specimens exhibited for sale by the itinerant hawkers who pervade the streets of the metropolis and other large towns.

Besides the British species there are many other squirrels found in different parts of the world, Australia being the only continent where none are known to exist.

Particular attention is drawn to this point, because in nearly all travellers' accounts of Australia we read of the flying squirrel among the quadrupeds inhabiting that land. In fact, however, the so-called squirrels are not squirrels, nor even rodents, but are Marsupials, belonging to the great group of Phalangists.

The mistake arises from the natural errors made by travellers and colonists, who name every creature they see after the inhabitants of their own country.

South Australian colonists talk and write with marvellous composure of wolves, bears, monkeys, bats, cats, squirrels, rats, and mice as inhabiting the country. Similarly American writers sadly bewilder the tyro in zoology by mentioning American buffaloes, lions, tigers, and panthers, all these creatures being strictly confined to the old world. The 'Robin' again, so often mentioned in American literature, is not our English redbreast, as is usually assumed, but an erroneous name for the migratory thrush, a bird far larger than the redbreast and belonging to a totally different group.

The squirrels belong to the great division of the rodents, which comprise nearly a third of all the known mammalia. The animals of this group are distinguished by the possession of two powerful chisel-edged incisor teeth in each jaw, formed for cutting or gnawing away hard substances, and which are replaced by fresh material as fast as they are worn away. The power of these incisor teeth is strikingly exemplified in the beaver, which has been known to gnaw its way through logs no less than eighteen inches in diameter.

Were there not some means of replacing these teeth as quickly as they are worn down, the death of the animals would speedily follow, as they would shortly starve from their inability to procure food. In order to avoid this, the teeth are continually forced forward from the jaw by the formation of fresh substance at the base, which is secreted by a pulpy substance at the root of the tooth. Now, as this growth takes place whether the teeth are used or not, it follows that, unless they were in constant use, they would soon increase to an inordinate length, and before very long would project from the mouth. Such an event does occasionally occur, when by some accident one of the incisor teeth has been broken short off. The corresponding tooth in the other jaw, finding no resistance to its growth, continues to increase until it sometimes forms a perfect circle outside the mouth, usually resulting in the death of its owner by preventing it from feeding.

Without some means, however, of preserving the chisel-like sharpness of these teeth, the mere replacement of wasted substance would be of little use. In order to obtain the desired result, the teeth are constructed after a very singular fashion.

The body of the tooth is composed of pure ivory, coated on the outer surface with a thin layer of enamel, which being of a very much harder nature, is not worn away with the same rapidity. Besides this, the ivory nearest the enamel is harder than the rest, and the softer parts being easiest worn down, the edge of the tooth always keeps the same proportions, the actual cutting being performed with the edge of the enamel.

Our carpenter's chisels are constructed on exactly the same principle, the chief portion of them being composed of soft iron, while a very thin plate of steel is laid along the back and forms the cutting edge of the tool.

So much for the characteristics of the rodents as a

whole. Now for those of that branch which are known as squirrels.

The true squirrels are scientifically known as *Sciuridæ*, or shadow-tails, a title derived from two Greek words, the former signifying a shade and the latter a tail. This refers to the habit in these animals of carrying the tail over the back, as though to protect the body from the rays of the sun, a position always adopted except when running or leaping. They are remarkable among the rodents as possessing particularly perfect clavicles or collar-bones, which enable them to use the fore-paws to a certain extent after the manner of hands. This is especially the case in carrying food to the mouth, when the paws are managed with extraordinary dexterity. In eating a nut, for example, a squirrel, by the aid of its fore-paws and teeth alone, will break the shell and peel the kernel to the full as successfully as a skilful human being furnished with crackers and penknife. And it does so as follows. Holding the nut close to the teeth, it gnaws away at the point of the fruit until it fairly pierces the outer shell. It then dexterously inserts the edge of

Squirrel's Summer Nest.

the upper teeth into the aperture, and splits away the shell just as an idle boy does with his knife when opening nuts in school hours. By means of its hand-like paws, it then holds the kernel against its upper teeth, and rapidly turning it round and round, strips off the whole of the peel before beginning to devour it.

With the exception of the jaws and the adjacent parts of the head, the skeleton is exceedingly slight and fragile in order to suit it to the rapid movements of the animal.

To furnish the squirrels with the means of ascending the trees in which they spend the greater portion of their existence, the long toes are provided with sharp, curved claws, which can be inserted into the smallest crevices of the bark, and thus secure a firm foothold.

The rapidity and ease of their aerial motions is something astounding. A squirrel will gallop up a perpendicular tree trunk fully as fast as a cat can run on level ground, and will throw itself from branch to branch with the most perfect recklessness. And even if it misses its mark, it simply extends its limbs and

allows itself to fall to the ground from most wonderful heights, never seeming to be in the least damaged by its rapid descent. One would imagine that the creature must infallibly be dashed to pieces, but, almost before one can look round, the squirrel is off to the nearest tree trunk, where it is quickly lost to sight amongst the foliage.

As a refuge both by day and night, and also as a place wherein to rear their young, the squirrels always construct a large and comfortable nest, generally in the fork of some lofty branch, and always carefully concealed from sight. The materials are chiefly leaves, grass, and moss, woven together in a most beautiful manner, and forming a perfect protection against the rain. The old nests may sometimes be seen in winter when they are no longer surrounded by foliage, and stand out boldly among the naked boughs.

In these nests the young, three or four at a litter, are brought up, and remain until they are old enough to shift for themselves.

At the approach of winter the squirrels, not being able to find their food during the cold months, lay up stores for use during that period. Their provisions consist generally of nuts of various sorts, grain, beech-mast, and so on, and are hidden away as a rule in holes at the roots of trees in the neighbourhood of their winter habitation. It is a somewhat curious fact that the squirrel never includes a bad nut in these hoards.

This winter retreat is also a nest of much the same character as the former, but hidden away in holes in trees, the junctions of large branches with the trunk, and similar localities. As soon as the cold weather fairly arrives, the squirrels, having previously laid up their winter stores, repair to this hiding-place, and there pass the time until spring, when they again return to their summer haunts. For the greater portion of the intervening period they lie in a state of complete unconsciousness, something more than sleep and less than death, and which can be only partially described by the word 'trance.' This state is not, as is generally imagined, produced by intense cold; for should the temperature fall below 32° Fahrenheit, or 'freezing-point,' a hibernating animal is first awakened and then killed by the frost. Those animals, therefore, which pass the winter in a state of unconsciousness, always select a retreat where they are sheltered from the direct action of the elements, and where the temperature is only slightly varied.

While in the hibernating condition respiration entirely ceases, and the animal could be kept for hours under water, or in a vessel of carbonic acid gas, without the slightest effect. The circulation of the blood is greatly retarded, and digestion, at any rate in those animals which spend the whole winter in unconsciousness, is wholly at a standstill.

The squirrel, however, is only a partial hibernator, and is obliged to leave its hiding-place three or four times during the winter months in search of food. For this purpose it always selects a milder day than usual, and on such occasions may be seen repairing to its stores for a meal before again proceeding to its place of refuge. These hoards seem always to be more than sufficient for its wants, and the remainder of the provender is left to its fate. Sometimes the nuts, etc., take root, and the squirrel is often the cause of trees springing up in unexpected places.

In the far north the cold of the winter has a very marked effect upon the fur of these animals, which from a rich brownish red becomes of a pale grey hue. And even in our own climate there is a perceptible change in the colour of the fur at different periods of the year.

Squirrel's Winter Nest.

It is not generally known that squirrels can use their paws as paddles, and by their aid swim to considerable distances.

In some parts of the eastern coasts of Scotland, where innumerable armlets of the sea run many miles inland, the squirrels are in the habit of swimming across from shore to shore, and making rapid progress through the water. A friend was an eye-witness of this habit. Being in a boat, he came upon the little creature as it was swimming, and took it into the boat.

As it was tired with its journey, it allowed itself to be caught without any difficulty. But as soon as it felt itself rested, it sprang back into the water and swam steadily to land.

Leaving this country for America, we find there are many kinds of squirrels found in that country, several of which are very interesting. For example, there is the Grey Squirrel (*Sciurus cinereus*) of North America, which is extremely abundant, and often works very great damage to the growing crops. In Pennsylvania, more than a century ago, these animals were found to be so very destructive that a Government reward of threepence per head was offered for all that were killed. In a single year, a sum of no less than £8000 was expended in redeeming this promise, which gives a grand total of 640,000 squirrels destroyed.

Now, although these animals wrought such terrible mischief to the agriculturist, and by their numbers and perseverance ruined the result of his labours, in their native forests they were in their proper situation, doing the work for which they were sent into the world. But as soon as man arrived upon the scene, cleared away the jungle, and laid out the ground for cultivation, he upset the balance of nature: the squirrels were no longer required, and became a plague instead of a benefit, making it necessary to thin their number. Even our own squirrel is occasionally the cause of much damage, especially in young plantations, where it has a habit of nibbling off the topmost shoots, and so stopping the growth of the tree. Nor does it confine its depredations to vegetable life, for it is by no means uncommon to find a bird's nest ransacked by the animal, and the eggs or young ones devoured, as the case may be. It is probable that the squirrel is the real delinquent in many a case of nest-robbing when the blame falls on the shoulders of thoughtless schoolboys.

It occasionally happens with the grey squirrels, that, having pretty thoroughly devastated a neighbourhood, and finding winter approaching, they are unable to lay up a sufficient stock of food on which to subsist until the spring. Knowing instinctively that if they remain in their present locality they must inevitably die of starvation, they migrate in vast numbers, after the fashion of the lemming in Northern Europe, allowing nothing to check their course, climbing over instead of avoiding any obstacle, such as a wall or house, and leaving nothing eatable behind them. Every blade of grass and every green thing disappears, and the transit of one of these hosts leaves the country in much the same condition as if a swarm of locusts had passed over it.

Then there is the Black Squirrel (*Sciurus niger*), which, though not nearly so numerous as the preceding species, is still far from uncommon. It is a curious circumstance that the black and the grey squirrels seem unable to live in company, and as soon as the latter animal shows itself, the former disappears. As its name implies, this animal is of a uniform black hue, and from the fineness of the fur, is much sought after for the sake of the skin.

There is a somewhat strange-looking squirrel inhabiting Borneo, and which is popularly known as the Long-eared Squirrel (*Sciurus macrotis*). It is thus named on account of the singularly long fringe of hair with which the ears are decorated, which is of a dark brown colour, and pretty well two inches in length. The tail also is remarkably bushy.

Besides all these, there are some animals, none of them inhabiting this country, however, which are generally known as 'flying' squirrels on account of a singular modification of structure. This is found in the skin of the flanks, which is developed to a large extent, almost hiding the paws in its folds when the creature is at rest. When in motion, however, and particularly during the tremendous leaps which these animals make from branch to branch, the legs are stretched out as far as possible, the loose skin acts as a parachute, and the squirrel is enabled to pass through a much greater distance than would otherwise have been possible.

The petaurists of Australia possess a similar development of the skin, and use it for a similar purpose.

One of the best known of the flying squirrels is the Taguan (*Pteromys petaurista*) of India, which is of a brownish colour, varying from deep chestnut along the back to a greyish white on the under surface of the body. The tail is long and bushy, and very much darker in colour. The whole length of the animal is nearly three feet.

Leaving the true squirrels, we come to a very closely allied branch, the members of which, however, construct their habitations beneath the earth instead of among the branches of trees, and but rarely leave the ground. These are called ground squirrels, and are furnished with cheek-pouches, which the true squirrels do not possess. The object of these we shall presently see.

The Hackee, Chipping Squirrel, or Chipmuck, as it is indifferently termed (*Tamias Lysteri*), of North America is one of the most widely known of these quadrupeds. It is a very pretty little creature, rather less than a foot in total length, of a brownish-grey hue, with five black and two yellow stripes running longitudinally along the back. The under surface is of a fine white.

The hackee is very abundant over a great portion of North America, and may be seen almost everywhere dashing in and out of the underwood with a rapidity which has caused its movements to be compared to those of the wren.

By way of habitation, and also as a refuge from its numerous foes, it constructs rather complicated burrows below the surface of the earth. For this purpose it generally selects some protected situation, such as the roots of a large tree, the side of a bank, or the foot of a hedge. A winding tunnel, usually of considerable length, leads to the dwelling chamber, or nest, where the young are brought up, and from this run galleries leading to other chambers which are used for storehouses. In these a most astonishing quantity of food is laid up. In a single nest, we are told, were found no less than a peck of acorns, two quarts of buckwheat, a quart of beaked nuts, some grass seeds, and a quantity of maize, with which the interstices were filled up.

It seems almost incredible that so small an animal as the hackee can lay up so large a quantity of food, but such is the case, and it is in carrying the provisions to the burrow that the use of the cheek pouches is found. It can, of course, carry only a small quantity at a time. Four beaked nuts, for example, constitute the load for a single journey, three being packed into the pouches, and the fourth carried between the teeth. In order to prevent the nut from hurting its mouth, the hackee invariably bites off the sharp beak of the fruit before consigning it to the pouches.

When thus loaded, the animal presents a very curious appearance, bearing a ludicrous resemblance

to a human being suffering from a very bad attack of mumps.

The well-supplied condition of the hackee's larder is widely known, and in times of scarcity the natives repair to the burrows, and, digging out the contents, find the materials for a hearty meal.

When pursued by one of its numerous enemies, the chipping squirrel always takes refuge in its burrow, trusting in the inability of its pursuer to follow it down the complicated windings of its narrow tunnel. There is one foe, however, to whom this is no obstacle, and which follows the hackee to the very end of the burrow, there making a meal of the unfortunate owner. This enemy is found in the stoat, which sometimes kills the whole of the occupants of a burrow merely for the gratification of sucking their blood.

All three of the popular names are applied to this animal on account of the curious cry, which somewhat resembles the clucking of newly-hatched chickens. The scientific title, *Tamias*, is a Greek word, signifying a storekeeper, the application of which is at once apparent.

Short Historical Anecdotes.

BY REV. SIR GEORGE W. COX, BART., M.A.

(1) The Emperor Akbar and his Subjects.

THE most splendid court in the sixteenth century was that of Akbar, the greatest of the Mogul emperors of Hindustan. He was born at a time when the fortunes of his father Humayun were at their lowest ebb. When he was four years of age his mother took him to Cabul, which Humayun had succeeded in reconquering. The Emperor took the child into his arms, and said, 'Joseph was cast by his brothers into a well; but he was raised, as thou shalt be, to great glory.' His hope was abundantly realized. The life of his son was marked throughout by the strongest sense of duty; and duty with Akbar embraced the whole field of human conduct. Undauntedly brave in battle, he was full of mercy for the conquered. After one of the many battles fought on the field of Panipat, the Hindu general of the defeated army was brought before him by his tutor Behram Khan, who commanded him to strike off the head of the infidel. The boy, then fourteen years of age, burst into tears, and lightly touched the prisoner with his sword; but Behram, in no way satisfied with this mere sign of conquest, cut him down. Behram would have made the young emperor a conscientious Mahometan—that is, one who can tolerate no faith but his own. But Akbar had scarcely reached manhood before he became convinced that though persecution may make men hide their opinions, it produces no change in them, and therefore fails in its own ends. His enemies accused him of being a persecutor himself; but the only instances of persecution recorded of him are the following. When one of his courtiers asked him what he supposed that orthodox Mussalman princes in other lands would say of him, Akbar ordered him to leave the room. When another told him that he was following the counsels of 'hellish' advisers, the Emperor said that such language assuredly deserved a blow; but the blow was not inflicted. Later in life he published his creed to his subjects. It was simply this—that God should be reverenced and loved by all; that all were bound to serve and worship Him by living righteously, and by doing the good which would promote the welfare of their fellow-creatures, and bring to themselves the peace of a quiet conscience. For an account of Akbar's system of government, see Cox's *History of the Establishment of British Rule in India.*

(2) The Emperor Shah Jehan and Sivaji.

The name of the Mahrattas was for ages a sound of terror throughout Hindustan; and the power of the Mahrattas first became formidable in the time of Shah Jehan, the grandson of the illustrious Akbar. The struggle between the Mogul emperors and the Mahratta chiefs was the struggle between the Mahometan and the Hindu religions; and it was with the special purpose of regaining for Hinduism its old predominance that Sivaji, the founder of the Mahratta empire, braced himself to his work. He had grown up among the wild hills and valleys of the Western Ghauts; and with books and learning he would have nothing to do. He would not be taught either to read or to write, but he put an undoubting faith in the revelations which his mother said that she had received from the goddess Bhowani, and which announced his future greatness as the restorer of Hinduism to its ancient supremacy. He first gained possession of a hill fort at Poona, and was lucky enough to find in it a hoard of gold, which enabled him to repair its works and build another fortress on a neighbouring hill. At last he ventured to lay hands on convoys bearing treasures for the emperor; and Shah Jehan retaliated by placing Sivaji's father in a dungeon, in which he was walled in up to the shoulders, and telling him that the remaining bricks would be put in their places unless he immediately brought about the submission of his son. Sivaji, unable to resist this argument, threw himself on the Emperor's favour, received his forgiveness, and having obtained his father's freedom, betook himself to his old ways, building for his stronghold the impregnable fortress of Pertabgurh, on the summit of a hill a few miles to the south of Poona.

(3) Clive and Omichand.

The exploit of Clive in seizing and holding the fortress of Arcot is amongst the most memorable of military enterprises in the history of India, and perhaps of any other country. He had with him only 500 men, and of these 200 only were Europeans. Of the eight officers who accompanied him, four only had had any military training, and two only had been in action; the rest were clerks who had just left their counting-houses. With this force he marched through a tremendous storm of lightning and rain, and by so doing struck terror into the garrison, which abandoned the fort and allowed him to enter it unopposed. For fifty days he held it against overwhelming odds; and his final victory ensured the establishment of British rule in India. It is strange that a man thus great in legitimate war should have stooped, in subsequent dealings with the nation of India, to make use of those weapons of intrigue and falsehood which are as congenial to the Eastern as they are abhorrent to the English mind. When the conspiracy was formed for putting to death the Nawab Suraj-u-Daula, whose name is infamous for his share in the tragedy of the

Black Hole of Calcutta, Clive did not hesitate to join it. His agent was a merchant named Omichand; but Clive was, or seemed to be, astonished when Omichand demanded a sum of not much less than half a million sterling as the price of his secrecy, and insisted that this compact should be sanctioned by the treaty between the English and the man who was to be put into Suraj-u-Daula's place. Clive agreed to the terms, but he had two treaties drawn up—one on white paper, one on red, the compact being named only in the false one, for which he forged the signature of Admiral Watson. When Clive's great victory at Plassy made it necessary to carry out the treaty, he received Omichand with his usual graciousness; but when the treaty on white paper had been read, Mr. Scrafton, on a signal from Clive, turned to Omichand and informed him that the treaty on red paper was a trick, and that he was to have nothing. Omichand, it is said, fell back insensible, and when brought back to consciousness was little better than an idiot. This has been denied; but it has no bearing on Clive's share in the business. Happily, Clive's example has not been followed by Englishmen in India, and Lord Macaulay has well said that the one great lesson enforced by the whole history of British India is that it is not prudent to oppose perfidy by perfidy, and that the most efficient weapon with which men can encounter falsehood is truth.

(4) The Black Hole of Calcutta.

The tragedy of the Black Hole of Calcutta is a terrible commentary on the evils inherent in eastern despotism. In one sense it was an accident, but it was an accident which could never have happened in a country where the rulers are compelled to remember that they owe a duty to their subjects. Suraj-u-Daula never meant that his prisoners should be stifled to death; but they were stifled to death because, before he went to sleep, he had given no orders about them, and his officers dared not at the peril of their lives disturb him while he slept. In fact, this wretched youth (he was barely seventeen years old) had been brought up in the belief that his own pleasure was the one end to be aimed at by every one in everything, and he had learnt the lesson greedily. He saw that the English settlement in Calcutta was rising in importance; he believed the English to be the possessors of almost unimaginable wealth, and he resolved to seize their treasures and expel them from the country. It seemed at first as though he would succeed in his enterprise. The governor fled with the women and children to the ships, which dropped down the river, leaving those who remained behind to their fate. These were overpowered by the enemy, who rushed in when the gates were opened to admit a flag of truce sent by Suraj-u-Daula; and the prisoners were brought before the tyrant, who assured them that their lives were safe, and that no harm should befall them. But his mind was running on his personal disappointment. He had expected to find millions in the Calcutta treasury; he could lay hands only on £50,000. So he went off to sleep without saying a word about his captives. Their guards, who dared not disturb the Nawab, insisted that the prisoners, 146 in number, should all go into a room about 20 feet square, lit by a single small window. It was a dungeon in which two or three refractory soldiers may have been confined at a time; and into this Black Hole the miserable prisoners were driven at the point of the bayonet, and the door was locked upon them. The fierce heat of an Indian mid-summer's night intensified the agonising death struggle, while their entreaties to the guards to fire upon them and end their misery were received with shouts of mocking laughter. In the morning sixteen only remained alive. For all these things Suraj-u-Daula cared nothing. He had no thought except for the treasures for which he was still vainly searching; but even the native historians have not a word to say about this horrible catastrophe. The truth is, that the people of India are among the kindest in the world, but they heed nothing beyond the narrow circle of their family and their caste; and thus, such an incident as that which has made the memory of Suraj-u-Daula infamous among Europeans, passes with them as a matter of course, not worth the mentioning.

(5) The Defence of Korygaum.

The struggle between the Mahrattas and the English was marked by two instances of singular heroism on the part of British officers. The Peshwa, or minister who had long since usurped the powers belonging to the successors of Sivaji, was evidently striving to gain his ends by systematic treachery, when Mr. Jenkins, the resident at Nagpore, placed on the neighbouring Sitabuldi hill a force of 1400 Sepoys, with three troops of Bengal cavalry, and four six-pounders. With these troops a battle, begun in the evening, was carried on through the night against a Mahratta army of nearly 20,000 men, with six-and-thirty guns, and was decided the next day by the bravery and skill of Captain Fitzgerald, the commander of the Bengal horse. The Peshwa now sent for the representative of Sivaji from Satara, and pretended to rule in his name; but his plans were foiled by the splendid defence of Korygaum, by Captain Staunton, who, on Jan. 1, 1818, with 34 Europeans and about 750 native soldiers, defended the village until nightfall against the Peshwa's army of 25,000 horsemen and 6000 infantry. The Mahrattas refused to renew the fight the next day, and the Peshwa was driven to seek safety in flight.

(6) India under the Great Mogul.

In the year 1735, two Englishmen, dropping down the river with a convoy of treasure from Patna to Calcutta, saw a boat going by with baskets, which they supposed might contain fish; but in them they found thirty human heads. On that day, according to a long-standing agreement, the Raja of Monghyr had set out with thirty men to pay his tribute to the Nawab Alavardi Khan. The latter was likewise pledged to send only the same number to receive it, but with these he sent another force which was to lie in ambush. When the Raja came with his men, all were murdered except one, who carried the tidings of the massacre to the Raja's wife. She set the palace on fire and died with her son in the flames. That night the two Englishmen saw the smoke and blaze of a mighty conflagration as they lay at anchor in their boat on the river. The troops of Alavardi Khan were sacking and burning the city. Such was a specimen of government in Behar by a deputy of

the Viceroy of the Great Mogul, before the English brought order and peace to the country.

(7) Willoughby and the Magazine at Delhi.

The great Sepoy Mutiny shook the British rule in India to its foundations. It also brought out wonderful instances of bravery and heroism on the part of British officers and soldiers; and among these the devotion of Lieutenant Willoughby and his comrades stands conspicuous. Willoughby was in charge of the great magazine at Delhi, when the mutinous regiments who had hurried away from Meerut crossed the bridge over the river and made their way into the city. The magazine contained an immense store of powder and ammunition; and its contents would be invaluable for extending and maintaining the rebellion. The mutineers were well aware of this, and, aided by the mob of Delhi, which was always furiously excitable and turbulent, they brought their whole strength to bear upon the position. They were further aided by the Sepoys of the regiment which had been stationed in the city to guard the magazine. The people surged in crowds before its walls, and messengers, speaking in the name of Bahadur Shah, the pensioned representative of the old Mogul emperors, demanded its surrender, and were met by an absolute refusal. The defenders stood out as long as they could, but the ammunition at hand was soon exhausted, and it was impossible to leave the guns to bring more powder. Willoughby saw that there was no alternative for men who were determined to do their duty. On his giving the signal, a train previously laid was fired, and some fifteen hundred rebels were blown into the air with the contents of the magazine. Willoughby with two or three companions escaped to Meerut, maimed and mutilated; but his injuries were mortal, and he died a few weeks later after terrible suffering, leaving a name which Englishmen will not allow to be forgotten.

(8) Xerxes and Demaratos.

In his invasion of Greece, Xerxes had with him Demaratos, a deposed Spartan king. After the first general review of his unwieldy army, Xerxes asked the Spartan whether his countrymen would dare to oppose so overwhelming a force. On receiving his assurance that no harm should befall him for telling the truth, Demaratos told him frankly that if a thousand Spartans set out, they would most assuredly fight him. Xerxes laughed. 'What! a thousand men fight my great army! Come now, you were once their king; will you fight ten men? Yet if each of these will match ten of mine, you ought to match twenty. But if in size they are like the other Greeks whom I have seen, you must be only boasting. Let us reason it out. How could a thousand, or a myriad, or five myriads, who are all free, and not ruled by one man, withstand a host like mine? Why, we are more than a thousand to one, even if they were five thousand. If, like my people, they obeyed the will of one man, and were driven on by the scourge, they might stand out against numbers larger than their own. But of course, being free, they will not do so. Besides, if their numbers were equal to mine, I doubt if they could withstand us. Why, I have among my spear-bearers many men who will fight three Greeks at once.' Demaratos, by way of answer, confessed that he did not suppose that Xerxes would like to hear the truth, adding that he had spoken only from a sense of duty, since, as the king well knew, he bore no love to the Spartans. 'They have robbed me of my power, and driven me to a strange land where I was kindly received by thy father. Is it likely that I should set lightly by the kindness which he showed me? As for myself, I do not say that I am able to fight with ten men or with two. Of my own choice I would not fight with one; but if fight I must, I would take my chance with one of those whom thou thinkest equal to three Greeks. So, too, the Spartans one by one are like other men; but taken together, they become terrible to their enemies, for, though they are free, they are not without a law. Law is their master, whom they fear much more than thy people fear thee. Whatever law commands, that they do; and it commands always the same thing, charging them never to fly from any enemy, how strong soever he be, but to remain in their ranks, and to conquer or die.'

(9) Gelon and the Greek Envoys.

When the invasion of Greece by Xerxes began to look like a certainty, the Athenians and Spartans tried to secure the aid of the Greek cities in Sicily. But when their envoys, appearing before Gelon, the tyrant of Syracuse, warned him that the ruin of the Eastern Greeks would assuredly be followed by his own, Gelon reproached them bitterly for having left him to his own resources when he asked for their help against the Carthaginians. 'But I will not,' he said, 'deal with you as you have dealt with me. I will give you 200 ships and 20,000 men, with corn for all the army of the Greeks as long as the war shall last; but I can do this only if you will make me leader and chief of all the armies of the Greeks.' 'It is impossible,' the Spartan king replied; 'the children of Agamemnon cannot yield their place and their honour to a Syracusan. If you choose to help the Greeks, you must do so under the Spartans; if you will not, then stay at home.' Gelon kept his temper. 'My Spartan friend,' he said, 'abuse commonly makes a man angry; but I do not mean to pay back insults in kind. Let us make a compromise. If you rule on land, I will rule at sea; if you rule by sea, I will rule on land.' But here the Athenian envoy broke in: 'King of the Syracusans, the Hellenes have sent us not because they want a leader, but because they want an army. Of an army you say little; about the command much. When you asked to lead us all, we left it to the Spartans to speak; but as to the command at sea, we cannot yield it. It is our birthright.' 'You seem likely to have many leaders,' retorted Gelon, 'but few to be led. But since you will yield nothing, and grasp everything, go home and tell the Greeks that the spring-time has been taken out of their year.'

(10) Dienekes at Thermopylæ.

Before the fight in the pass of Thermopylæ, in which Leonidas and his three hundred fell, a man of Trachis, it is said, told Dienekes the Spartan that when the Persians shot their arrows, the sun was darkened by them. Dienekes answered cheerily, 'Our friend from Trachis brings us good news: we shall be able to fight in the shade.'

How to write an Examination Paper.

BY W. P. WORKMAN,

First in Honours, June Matriculation, 1880, and Senior Cambridge, 1878; also, First in Pure and Applied Mathematics in Senior Oxford and Senior Cambridge, 1878.

TO the young student, for whom these remarks are chiefly intended, examinations appear in a very different light from that in which the 'old hands' view them. To the latter they no longer seem decked with pretty colours, even from a distance, for nine or ten trials dispel all that sort of illusion, especially if in two or three of these, anxious eyes fail to find on the list the name they seek. But to the first examination, candidates generally look forward as to a week of varied pleasure, all the more enjoyable because of its freshness.

And these haloes of anticipation are in truth the very greatest of the dangers to which the neophyte is exposed. For an examination is not a week of somewhat amusing novelty, but one of unmistakeably disagreeable scribbling—six hours a day, and not an instant's rest for any who wish for success. If this fact is left out of consideration, the first day or two will be almost entirely wasted. The work is real, and must be done right well, or it were better left undone.

Of course, if the candidate always acts in accordance with the superlatively impossible maxim of never wasting any time, then there will be no danger from this source. But it is a matter of experience that boys, at any rate, certainly *will* waste time, and will absolutely refuse to be always working, and that even those who consider themselves quite free from this fault may often be led into it at seasons such as these.

Let it then be a settled rule for the candidate to try his utmost not to lose a moment until the paper is finished—not even by reflecting how pleasant and creditable it is to be an examinee, or, and the thought is common enough, how nicely or how badly that last question was done. For two minutes lost means a place on the list. In the Matriculation, for instance, though the maximum number of marks is 2800, probably 5 or 6 represents the extreme difference between two consecutive men on the classified list.

Preparations should all have been made before the time actually comes to test their value. At any rate, it is utterly ruinous to think of making them all at the last. The week of an examination may be employed for rounding off the angularities of your knowledge, and adding a little here and there, but to spend much time then in this will be fatal to all chances of success. During this period, which, depend upon it, will be a harder tax than you expect, do not rise very early and sit up very late in order to work up the subject of the next paper. The chief aid to health of mind is health of body. Take a run on the hills when the crowded room can be safely left. Let the fresh breezes clear your racking brain of all the accumulated cobwebs of toil. Follow not our super-studious friends, who go from six hours' hard work in a hot room to six hours' harder work in a hotter study, of which the results are quite too plain next morning in their flushed faces and fevered cheeks. Your learning is not worth much if it is imperfect without those pitiable last looks at the book, or last hints from the coach, of which you will see more examples in one week than you would care to do in a year.

But having taken these precautions to keep physically cool, take care also, as far as possible, to preserve mental coolness. Do not walk into the room all in a hurry, anxious to write down this and that 'crammed-up' fact ere it escapes your memory. Do not imagine the questions are too hard, and lose your temper, or that they are too easy, and you won't gain as much as you expected on your rival. Leave all those salutary reflections till afterwards. Also do not be always thinking you are 'floored' already, and it is no use to try any more. This is one of the most senseless and at the same time most frequent faults into which candidates may fall. For are they always the best judges of their own performances? And do they always know the minimum standard for success? In three-quarters of the cases that will present themselves, even the examiners do not know beforehand. If this be true, is it not foolish to lament over a failure when there is no certain proof of its existence? At any rate, if we go so far as to suppose that you only got a quarter of that arithmetic paper right, is there not a great chance that the mathematical examiners will let you through on such a small proportion as this if you happen to shine with particular brilliance in Euclid? It will not do any harm to trust to probabilities of success—far less harm, at all events, than to be discouraged by possibilities of failure.

But let it be supposed that the candidate is not deluded by vain anticipations of pleasure, and that he is absolutely determined to waste not an instant of the time which he knows to be so precious; let it be granted also that he is so cool and collected that nothing short of the fall of the roof on his head can disturb him; there still remains the important question of how he may show off his knowledge to the best advantage.

A method of reasoning as fallacious as common is this:—'Question x is a very hard one: they will give 50 marks for it; Question y is much easier: it will carry 25. I can get half of x right, three-quarters of y; then x is more profitable.' Nonsense! y is. For you would spend twice as much time on x as on y, and you would be just one-quarter more *thorough* on y. Now of all qualities, thoroughness is the most valuable, and not less because it is so uncommon. A slipshod is known at once. His knowledge is shallow, sometimes transient. On this account, unfair though it may seem on the face of it, his answers are depreciated, for with all examiners such a one is a marked and therefore a doomed man. Be assured of this—the thorough are always at the top, the shallow at the bottom, of any list whatever. Besides this, it is the rule in most examinations that all questions should count equally. This certainly is the case in the Matriculation and Home and Indian Civil Service. Hence the candidate who has reasoned with such elegance and force as to the precise relative value of certain questions, even if his answer to the one or the other be perfect, has been building his deductions on false premises.

Here, too, is the place to notice another piece of logic as fallacious and ultimately as ruinous as the first. 'I shall begin with the hard questions,' says

our supposed candidate, 'get them off my mind, and then start off with unencumbered energies to answer the easier.' And he begins with the hardest question, and finds it all too hard for him, and very quickly manages to get into a temper, and then, good-bye to a successful morning's work! He will be saved all such annoyances if he use the commonsense rule of 'easiest first.' If he climb his mountain of work by very gradual stages, he will scarcely notice the slope, and thus gain courage to face the difficulties which may await the end of his journey.

I will now suppose that my young Telemachus is fairly launched in his examination with, let us say, a mathematical paper before him. Since this is the subject which most of all requires the mind to be in good working order, it is the one in which self-recollection is most valuable. There are many problems presented which, through being in a hurry and not really thinking, the student passes by as above him, while if he had only resolutely attacked them they would have yielded at once to his assault. Usually the paper consists of a mixture in equal proportions of ordinary bookwork and problems. Following the rule of easiest first, do the bookwork, and then you will come to the problems, freshened with the comfortable feeling that at any rate you have done half—enough to get you through. As to the former, always give the neatest proof you know, taking care, however, not to sacrifice correctness to conciseness. As to the latter, you may nearly always obtain a hint how to start by referring to the previous question. In all Cambridge and most London papers, at any rate, this is so, for every problem that is set is attached to the piece of bookwork on which it depends. If this clue fails to lead to any very definite result, do not despair. There are very few problems incapable of being ultimately hammered out, if you only have patience enough. These few you may usually leave, relying on the hope that most other people will be forced to adopt the same plan. There *is* a sort of intuition which enables one to perceive in a moment what course is likely to bring a problem out, but to acquire this needs much practice. Geniuses may consider themselves able to see through any problem in the elementary branches, Algebra, etc., up to and inclusive of Differential Calculus, when they have worked say fifteen thousand problems in these subjects. Not to be disappointed, ordinary people should multiply this number by ten. This seems a Herculean task, but I think that no one who has thoroughly considered the point will set it down as Quixotic. Even if mathematics are not to be converted into tools for winning bread, they supply a finer and more complete discipline to the mind than any other branch of learning, forming, in addition to this, a pleasant companion for leisure hours, a plaything when we stand in need of rest from work, and an inexhaustible field for curious research.

As to the work previous to the examination in mathematics, the student will find enough problem-exercise in Wolstenholme,[1] or in some more elementary manuals. To get the text-books up, I would recommend the plan of keeping three note-books. After reading a chapter over and thoroughly digesting it, write in the first note-book a summary of those proofs which you think you will find any difficulty in remembering, giving especial prominence to the 'catchy' points. In the second, *summarise* the more important *results*, and *commit this to memory*. After this, work through the whole of the examples you find out at the end of the chapter; and if you come to any which, after having done them, you think of such a nature that you would fail to do them six months hence without a great amount of labour, write the solutions to these in the third book. If in this you persevere in Sisyphus fashion, you will find that you are gradually attaining that skill which you once so demonstrably lacked, and finally the stone of your difficulties will rest on the top of the hill.

In the classical papers, translation at sight takes the place of problems, requiring, in its turn, a vast amount of practice before success can be hoped for. Cicero's *Orations*, Cæsar, Livy, Vergil, Ovid, are easy Latin exercises; Xenophon, Homer, and Sophokles correspondingly easy Greek ones. Tacitus, Æschylus, and Demosthenes will do well for more advanced reading. It is very imperative that the grammar, as the framework of the whole, should be thoroughly mastered. In reading a work, the fresh words you meet with are of little importance, for you may never see them again; but the grammar and syntax will be constantly recurring, and are of infinite value. An eminent professor at one of the Universities makes it a rule, when reading Cicero, to 'look out' only the words which he knows, or rather thinks he knows. Others might follow the professor with advantage to themselves.

In English papers try to summarize, because there are few cases in which you will have too much time. Add every date you can think of in history. If the examiner is an author, get his book at your fingers' ends, and then quote him as an authority five or six times. But after all these things are done, this is a branch in which nothing but sterling knowledge can avail, and you should bend all your endeavours to the apparently unimportant subjects of history, grammar, etc. Time spent on these always repays with interest.

There is never too much time for a paper. Some men are very fond of thinking that they know twice as well as the examiner how much time is really required. You will do such wiseacres no great injustice if, when looking on the list for their names, you commence your search at the bottom. The examiners mean every minute of the time they allow to be employed in honest hard work.

But the arithmetical genius thinks that the two hours given to Preliminary Arithmetic in the Junior Oxford, say, were meant, not for him, but for dullards. Such geniuses I have known deliver up their papers fifteen or twenty minutes after the commencement, and think they have done a very clever thing. And then the geniuses reflect, compare answers with a plodder who has sat out the two hours, and discover omission after omission, and finally that the plodder is completely victorious. The old tale of Hare *v.* Tortoise is far truer than geniuses care to acknowledge.

Read everything; read it afresh; work out your results independently again and again, till the papers are called for, and then you may pride yourself on having taken all the precautions in your power to overcome all kinds of geniuses.

Never compare answers. It cannot alter them. It can only make you discouraged by continual wishes that you had written this or omitted that. But after

[1] Wolstenholme's *Mathematical Problems*. London, 1879. Macmillan.

the examination is all over, when it won't do any harm to shed a few tears on the subject, you cannot do better than refer to the book and learn up the parts in which you have proved yourself deficient.

The commonplaces of advice are too well known to need more than a mere mention—namely, attention to punctuation, spelling, writing, dotting of *i's*, etc. These said commonplaces will probably be presented to you in a printed form during the examination. You may follow most of them, not all. You may be told to answer the questions in the order they are set. This piece of advice you may studiously neglect, and do no great harm to your prospects. *If there is plenty of time*, you may be exact in punctuation, write in 'copy-book hand,' be careful about the arrangement, take great pains in English grammar, and expatiate to any degree on your pet theories or those of your friends. Under similar circumstances only may you enhance the charm or lessen the dulness of your answers by flowing epithets or learnedly-erratic disquisitions. But when you see that you will only just have time, crowd all sail in right good earnest. Never mind the commas; the facts are more important. Leave the 'copy-book hand' to other and calmer moments; write as fast as ever you can. Never expatiate, but try to present everything in a *tabular* form, so that the examiner, even if bothered by the lack of good spelling, or by the mannerisms of the writer and writing, may be cheered by your evident desire to please him and save his time: and remember always that *matter* is a more desirable thing than *manner*, and thoroughness the *summum bonum* of educational work.

But one final caution. Do not carry these liberties too far. Even examiners are human. Even a classical man, accustomed to Pindar, might be horrified at sentences four pages long, with not a single stop or dot from beginning to end. Even a great scholar, able to face his own writing, and most great scholars are bad writers, might be disturbed at the sight of the worst efforts of your hand. And it is highly probable that not many marks would be assigned to an illegible answer, even if written with more than ordinary skill. Remember that an examiner may have two or three thousand papers to read through, and is not particularly in love with you, and likely to pardon all your delinquencies; that they have tempers to lose and good graces to win; and that the best way to win them is not by writing hieroglyphics, which you yourself could not read an hour after their creation.

One youth of my acquaintance was not perfect in the art of caligraphy—in fact, his writing was so execrably bad that it was irreverently compared to the work of a spider with an inked foot crawling over a sheet of white paper. A change for the better in this brought about a decided improvement in examination results. Spiderly writing never prospers.

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'How I teach Arithmetic.'

BY WILLIAM SPENCER.

Author of 'Spencer's Exercises in Arithmetic.'

THE first query that presents itself to my mind in commencing this article is, as to whether I shall place it in inverted commas. As the title is not of my own choosing, I decide in the affirmative. This title will necessitate the use of the first personal pronoun; and as the writer prefers the singular number to the editorial 'we,' consequently, although the article will be somewhat egotistic, yet it is hoped that this characteristic will be more applicable in its literal than in its conventional meaning. Beside the title of my paper being furnished to me, I am further instructed that it is 'to be simply a description, such as you would give to a young teacher, of how this subject is taught throughout the school.' I am still further instructed to 'treat the subject fully, from the time you first teach the youngest child to count or add, till he leaves you, including Mental Arithmetic.' I shall presume that 'leaves you' implies rather when he *ought* to leave, that is, when he becomes a fairly proficient arithmetician, being able to work higher arithmetic generally, including Percentages in their many phases of Interest, Discount, Stocks, etc. As my paper is not a treatise on Arithmetic either as a science or an art, on both of which views much has been and still could be said, I shall not discuss its merits from either an educative or a utilitarian point of view, but at once proceed in strict accordance with my heading.

It is necessary to premise that my school, which is a mixed one, has an average daily attendance of about 260 (80 girls and 180 boys), and that the limit of age is from six to fourteen, a small number being under or over this limit occasionally. The school staff consists of head master, second master, three pupil teachers, two stipendiary monitors who teach each half the day, and two other paid monitors who each teach half the day. The school is divided into six classes, the sixth class—there being no infant school in connection—consisting of children below Standard work, and the weaker candidates for the First Standard. The number in this class, which is generally the smallest in the school, varies—more than any other class—from 20 to 40, and always occupies a small classroom. The other five classes are not very dissimilar in numbers; the first class is, however, always the largest, and the fifth class generally the next in size.

The majority of the children when admitted to the sixth class have little, and some scarcely any, notion of number, a few having absolutely none. I will begin with zero, taking 6 or 10 or any number of children that are in this state. I commence with a small number of visible and *tangible* objects—fingers, marbles, balls, etc. The *names* of numbers and their *consecutive order* up to 10 or 20 have generally been picked up at home or elsewhere, but these names are often mere sounds conveying no idea of any concrete number. Now by means of objects connect the name with a concrete idea in the child's mind: *one* ball, *two* balls, *three* fingers, *four* marbles, etc. The various degrees of progress in the First Standard may be conveniently arranged under the following stages:—

(*a*) Add and subtract concrete numbers up to 10. Here I let the children not only see the objects, but actually touch or handle them, as with young children of slow perception it is not always an undoubted fact that 'seeing is believing.' I would here remark that I prefer children learning by observation rather than by committing to memory any addition or subtraction table, being convinced that as the latter relies on memory alone, more errors will be made in practice than by the former method. Examples of procedure:—1 and 1, 1 from 2, 2 and 1, 1 from 3, 2 from

3, 4 and 3, 4 from 7, 3 from 7, 8 and 2, 2 and 8; 2 from 10, 8 from 10; 4 and 4, 4 and 5, 4 and 6, 5 and 5, 5 and 4, 5 and 3, 5 and 2, and every possible combination of two numbers that make 10, or of deductions from any number up to 10.

(*b*) Add and subtract *abstract* numbers up to 10. Here at the beginning concrete numbers are *referred to*, but they are not visible, thus bringing the imagination to work:—5 apples and 3 apples, 6 balls from 10 balls, etc. At this stage, children are required to put their hands behind them, and sometimes even to close their eyes, so as to make the process purely mental. *Mental* effort requires much encouraging: many young children, like some of larger growth, much prefer to use their senses to unaided thought. Hence you will sometimes see a boy in the higher Standards, even the Sixth, counting his fingers—a practice to be discouraged, as I generally find it is at once the result and a proof of mental laziness. Gradually make the numbers purely abstract:—6 and 4, 4 and 6, 4 from 10, 6 from 10; 7 from 10, 5 from 10, etc.

(*c*) Putting down and adding and subtracting *units* up to 10. Here, as in every subsequent stage, let the black-board be in constant requisition. Place the numbers (figures) under each other in a column which will amount to any sum not exceeding 10. We will assume that the children having had some practice in making figures, know all the digits, also the number 10 at sight. Examples for addition placed *over* each other:—3, 2, 1, 3; 4, 0, 3, 1; 5, 1, 2, 2; 3, 5, 0, 1, etc. For subtraction, *over* each other:—8—4, 9—2, 10—8, 7—3, 6—6, etc. After seeing a score of such done on the board, let the children do them from dictation on their slates. Here the child takes the first step in putting down numbers for himself, really the first step in arithmetic other than mental. Here attend to the character of the figures for neatness and shape, as well as to accuracy of result.

(*d*) Extend the above three stages up to the numbers 30 or 50. The concrete should not now be too much relied on, but still for children who have a strong faculty for the real (*res*), it will still be of service occasionally. Give plenty of examples, first on the board, then on slates. First in addition, where there is no 'carrying:' 12 and 23, 3+16+10, 21+11+4+3, etc. Then in subtraction: 38—23, 35—13, 48—36, 29—16, etc.

(*e*) Commit to memory the tables 2, 3, 4, and 5 times up to 10 each,—as far as 5 times 10. Illustrate by marks on the board; *e.g.* that twice 3 are 6, by making two groups of three strokes each, and then counting them to show that they make 6; that two groups of 4 each make 8, etc. I encourage the children to get them off at home, as it saves time and *noise* at school, it being difficult, if not harsh, or even cruel, to compel *young* children to commit anything to memory silently. Much testing is required to see that they know them accurately. Care is required that they can bear any amount of cross-questioning in them, and not simply able to gabble them consecutively. Examples:—5 times 3, 5 times 7, 3 sixes, 4 nines, twice 8, twice 6, etc. Ask a child a dozen or a score such questions; if he answers every one, he may be considered safe, but if he makes but one blunder in twenty questions, he must be further drilled in them. When the blunders are but few, and have got partly fixed in the child's memory, correct them in large figures on the board, and cause them to be repeated several times aloud by the children. The two most common errors I have found during many years, and still find, are—4 nines are 32, and 7 nines are 56. I have tried to account for these errors, but never could satisfactorily to my own mind.

(*f*) Practise oral drilling in *easy* short division. Examples:—How many fours are in 9, fives in 12, fives in 26, fours in 23, etc. Here concrete numbers may again be resorted to, till abstract ideas are gradually educed from them. These questions may be very advantageously mingled with questions in multiplication, as in last stage. At this stage also the cleverer children might be drilled in tens and scores up to 100; as, 2 tens, 3 tens, 5 tens, 9 tens, 10 tens, etc. Explain the import of the words 'twenty' (2 tens), 'forty' (4 tens), etc.—that the 'ty' implies ten. Also here, if not previously, I explain the 'teens,'—fourteen (4 and 10), fifteen (5 and 10), etc. Show that the 'ty' is *multiplied* by the previous part of the word to which it is affixed, and that the 'teen' (ten) is *added* to it. Then reckon twenties up to 100: 2 twenties, 3 twenties, 4 twenties, 5 twenties. Some notion of what 100 really is may be given from the balls in the frame, scholars in the school or in certain classes, ten children all holding up together their fingers, etc.

(*g*) I now teach Numeration and Notation up to 999. This subject is so thoroughly exhausted in every treatise on school management, that it is needless to go into detail here. Show that hundreds (below 1000) always require three figures, and that tens ('ty') require only two. Numeration should of course always precede Notation, it being easier to read off a number presented to the eye than to write it down in figures when dictated. Great care here will prevent much incorrect Notation in higher numbers. A thousand (1000) might now be represented, as it is the present required limit for the First Standard.

(*h*) Add and subtract numbers up to hundreds. First where no 'carrying' is required:—

231	201	496	874
413	422	234	530
222	113	262	344
103	240		
969	976		

Here it is necessary to explain the nature and use of the cipher, as, though being of no numerical value in itself, it is required to keep the other figures in their proper relative positions; so that each figure may correctly express what it is intended to do. Caution the children against calling the cipher 'ten,' as they are sometimes apt to do. We now enter upon the somewhat difficult task of 'carrying,' which may be illustrated in the working of the following examples:—

975	459	604
758	284	278
746	175	326
804		
3283		

I am aware that the process of carrying is differently taught, according as to whether its principle is fully explained, or only partially explained, or entirely

ignored. I adopt the medium course, explaining the above examples as follows. First add up the units' column, which comes to 23. I now put down the two figures (23) under the 04. Now show that the 2 must be added up with the tens' column, which amounts to 18. I now rub out the 2 to make room for the 8, placing the 1 under the 8 in the next (hundreds') column. The hundreds' column comes to 32, which we place to the left of the 83, having removed the 1 (temporarily inserted) to give place for the 2. Or, more shortly, the first column amounting to 23, put down the 3 and carry the 2 tens. In the second column put down the 8 and carry the 1 ten. I do not puzzle the children by calling these 18 *tens* = 180, but leave such remarks to be *incidentally* given, rather than formally taught, at more advanced stages. In subtracting the tens in the second example—8 from 5 we cannot; adding 10 to the 5 we have 15, 8 from which leaves 7. In carrying 1, I prefer in practice adding it to the 2 rather than diminishing the 4 by 1, the latter of course being more correct in theory, but I have found the former more successful in results.

As an experiment I tried the latter plan (diminishing the minuend) for about five years, but some years ago I reverted to the plan I had adopted during many years previous to the experiment. The chief difficulty was in working such cases as in the tens column in the third example above. The upper figure being 0, it cannot be diminished, and the true principle of taking 10 from the hundreds' column and then diminishing *it* (the 10) by 1, I consider too intricate for a child to easily grasp with his present limited attainments. Beside the above difficulty, there is the initial difficulty of 'borrowing' 10 from the 0.

I have observed the three following errors in working subtraction, which require to be specially guarded against:—(1) Taking the upper figure from the lower when the lower was the greater, instead of adding 10. (2) Forgetting to 'carry' 1. (3) Neglecting to *effectually* carry, as in the tens column of the last sum above; although the child says '1 and 7 are 8, 8 from 0 I can't, add 10,' he then says '*seven* from 10,' forgetting that he carried 1, or had to do so. While adding 10 to the cipher, he forgets he has added 1 to the seven: here special care is required. Here also commit to memory the tables up to 6 times 12.

The various steps required for the First Standard of the Government Code have now been *taught*, but the important question is, Have they been *learnt?* A considerable number of the slower children will still require weeks or months of patient drilling and practising before they can do the work accurately and quickly. *Accuracy* here should be specially encouraged, while *quickness* (or at least *hurry*) should rather be discouraged,—the latter will be attained by repeated practice.

At this stage of a child's progress, or earlier, depending on various circumstances—such as age, reading ability, general intelligence, length of time before inspection, etc.—he is removed to the fifth class, which consists of fifty or sixty children, occupying a gallery in the schoolroom. For the first six months or more after inspection this class consists of children who will, at the next inspection, be examined in the First or Second Standards. Here the tyro is made more proficient by seeing scores of examples worked out on the board, and by working on his slate. The sums he works are either (*a*) dictated, (*b*) set on the black-board, or (*c*) worked from cards ('Addition and Subtraction' from my own *Working Series of Exercises in Arithmetic*). I may here observe that, except during the quarter immediately preceding the inspection, little regard is paid as to what Standard a child will be examined in. A boy may be working compound rules and reduction of money who will only be examined in the Second Standard; and on the contrary, another boy who will be examined in the same Standard, having just pulled through the First, may still be working chiefly at addition and subtraction. It is unjust to give ten times the attention to a few slow-coaches that is given to the culture of the average, or of the few brighter intellects. These backward ones get *more* than their average share of attention, but the idol 'percentage of passes' is not slavishly worshipped.

I will now try to show the various steps in teaching this fifth class, premising that for arithmetic it is divided into an upper and a lower division, the latter being again often subdivided into (*a*) and (*b*). At times the whole class work together, especially for explanations, illustrations, and the working of copious examples on the board; and at other times the divisions work separately. (*a*) Multiply by numbers 2 to 6. Show that multiplication is a short method of doing a *certain kind* of addition—that is, reckoning the *same* number a given number of times. Take 368 and show that by putting it down three times and then adding them together we get the same result as multiplying it by 3, and that the mode of carrying is the same in both processes. I find multiplication much more easily learnt than subtraction, so that this step is soon taken when the tables are well known. (*b*) Commit to memory, chiefly as home lessons, the tables up to 12 times 12, and practise them as in (*a*). Here a great deal of cross-questioning is resorted to —hundreds of questions in all conceivable forms: 4 times 9, 7 eights, 8 sevens, 6 nines, 9 sixes, 3 twelves, 12 threes, etc. Show that 6 eights, for instance, and 8 sixes are the same, so that if not known when presented in one form, the child may be able to present it to himself in the other form. As the table becomes known, we drill well orally in questions in division: 5's in 20, 9's in 29, 7's in 38, 12's in 51, etc. Here I find progress very slow at first, and much help and simplifying required. Take 7's in 31; here a child at first flounders about bewildered, perhaps running over in his mind, or rather *memory*, *any* combination of numbers: 3 eights, 5 nines, 7 sixes, etc. Or he says to himself, *seven* 8's, *seven* 5's, *seven* 4's, etc. Here point out that he is presenting the question to his mind in the inverted form, as he does not want to know how many eights, fives, or fours there are in 31, but how many *sevens* there are. I ask him to try *any* number of sevens, and after much hesitation (not *thought* generally) he will perhaps say 8. Now show him that 8 sevens are 56, and that it much exceeds 31. Shall we now try more than eight, or less? He will now most probably try 7—still too much, he sees. He might now be allowed to run down by 6 and 5 to 4, which he would do of his own inclination; or, finding that 7 sevens is *far* too much, he might be induced to try a *much* less number. Suppose he tries *three* sevens—too few. At last he gets to *four* sevens are 28, and as five sevens are above 31, the true result

may now be got from him. Here 'line upon line' is required, as I find many children who are quite *au fait* in the whole of the table, however presented, who still require months of continuous drilling before they are proficient here. (*c*) Now, if not previously, teach Numeration and Notation to tens of thousands. I first give some idea of a thousand: 100 boys having each 10 marbles would amount to 1000 marbles, and 100 boys having 100 each to 10,000. Other illustrations are also plentifully given, as they are always found to well repay the labour bestowed; in numbers, a child relying more on his memory than on his imagination, he naturally eliminates the concrete. Having put down 3769, I cover the 3 with my hand, and the children read out the 769. Having just given some notion of 1000 and the figures by which it is represented, I elicit that the 3 represents 3000. Show that hundreds only never require *more* than three figures, and that thousands never require *less* than four figures. The board is now freely used in putting down numbers containing units of thousands. As I proceed I distribute ciphers liberally among the figures, till any number of four figures is quickly read out. Now proceed to tens of thousands, concerning which no further remarks are required, except that as the thousands now require two figures, there will be five figures in all. The process of notation is much simplified to a child's mind if he be taught to insert a comma between the hundreds and the thousands—40,609.

(*d*) We now proceed to work multiplication of two or more figures. Having multiplied by the units' figure, show that in commencing to multiply by the tens' figure the first figure of the product is placed under the tens' figure of the line just obtained, or that it is placed perpendicularly under the figure by which you are multiplying, which, as it holds good whatever power the multiplier may be, I try to impress well. Here it is necessary to cause each figure to be placed in its proper position, so that there may be no difficulty or error in adding the lines together. I do not here go much into the subtleties (to a child) of the decimal system of notation, for which there was a mania some twenty years ago, it being then strongly advocated that every step in the practical working of the simple rules even, should be accompanied *pari passu* with an exhaustive explanation of its theory.

As I have before observed, much of the theory of processes is incidentally taught by casual remarks when working on the board; and when a boy has obtained a fair amount of *practical* efficiency as an arithmetician, one or two lessons on the decimal and other scales of notation, with the theory of manipulation, can easily be given, and more easily comprehended than at each practical stage. Show here, if not previously, how to multiply by 10, or by any power or multiple of 10: 46×10, 870×1000, 78×40, 638×5000, etc.

(*e*) We now work easy short division, first liberally on the board, as with every other step in advance, and then on slates. As the children have been well drilled *orally*—see (*b*)—in exercises in division, the majority of them only require a comparatively short time to work such exercises satisfactorily. Division may here be shown to be a short method of subtraction; *e.g.* 6's in 26. Show that 6 could be taken successively 4 times from 26 and its consecutive remainders, leaving at least 2 as the remainder.

(*f*) We next work out *ad libitum*, on slates, exercises from addition to short division, to attain and also to test accuracy and rapidity of working. I will here give specimens of three lessons given on different days, each occupying about forty minutes.

(1) The following four sums are set on the board:—

(*a*)	760804	(*b*)	769237
	288467		65

(*c*) Subtract 73,408 from ninety-four thousand and twenty-one, then divide the remainder by eight.

(*d*) Multiply eighty-four thousand seven hundred and nine by 790, then divide what it comes to by 7.

The answers are examined by each passing his slate to his neighbour (not *ex*changing slates), after which the answers are called out, and the examiner of each slate puts a large cipher on each sum that is wrong, and a cross on each that is right. Slates are now passed back to the owners, and those who have four crosses (all right) are often allowed to go into the playground for a few minutes, while the sums are worked out for all who have one or more wrong. Other four similar or somewhat dissimilar sums are now set, and those who have the whole eight right—or seven, or six, according to circumstances—now work from cards (my own Exercises in 'Simple Multiplication and Division'). The answers are generally called to one or more temporary monitors from a higher class. So the lesson would be continued till the time expires, the poorer ones still working from the board and standing on the floor, while the better workers are successively sent to work from cards at their place in the desks.

(2) Another lesson might be as follows, all the sums being dictated instead of being set on the board. Example: Multiply 86,409 by 83, then divide the product by 9. The answer being called, each holds up his hand who has it right. Here much care and some delicacy are required, that every hand held up is honestly so; in each case a few of those said to be right being glanced at by the teacher, and a suspicious one now and then carefully examined. In this respect my theory is, that honesty fears no scrutiny, and dishonesty needs it. Another example might be: Take 36,409 from 71,080, multiply the remainder by 409, and then divide the result by 9. Here care is taken that the specific terms 'sum,' 'product,' etc., and the generic term 'result,' etc. are clearly understood, being repeatedly defined. When such sums as the last are given, being rather long, each might show his working when done, and go out if right, those who are wrong trying again and again till a reasonable time has been given. When children work the same sum while standing on the floor, great facilities for copying present themselves; but when each child is culled out as he is right, the chances of successful copying are much diminished, copiers being generally slow, while the quicker ones are soon right and off. In order not to send out too often those who are right, another sum would be dictated or set on the board for them while the teacher is doing the previous sum for those who were wrong. In this manner the whole of the forty minutes for the lesson is occupied, some ten or twelve sums being given in the time.

(3) Another lesson would be working *entirely* from cards (Multiplication and Division). Procedure:

—Give each a card, all standing on the floor, and tell them to do 2, or 3, or 4 sums, as the teacher thinks proper, and then go to their seats and do the remainder of the card. As there are eight sums on each of these cards, the slower ones would seldom do the last sums on the card, hence each is often told to do (say) the 2d, 4th, and 7th sums before doing the others. Here see that each does the specific sums he was told to do. Or they may be told to begin at the *last* sum and work upwards to the first; or again, before much proficiency is attained, some choice might be allowed; say, 'Do any three sums out of the first four,' or 'any two out of the last four,' etc. As some selection is often, or perhaps generally, allowed to adults in examination questions, the same privilege may often be advantageously granted to children; as, though a child should be encouraged to attack difficulties, it is unwise to keep him too long attempting what is to him impossible. Some of the quicker ones at this lesson will do 4 or 5 cards—30 or 40 sums; while several of the slower ones have not got through one card, and perhaps two or three have not done those required while standing. The first card given in this lesson might be in addition and subtraction, and the subsequent ones multiplication and division.

As before observed, the easier stages in multiplication and division are taught in the fifth class, and the more advanced stages in the fourth class, to which we now turn our attention. We here take up long division to complete the teaching of the simple rules. I first do a *short* division, say by 7 or 9, by the ordinary method, and then do it by the long method, and notice that the result is the same in each case. Divide also by any of the *teens* by both methods, which, however, we ordinarily work by the short method, as saving in time and space for working. Now take a greater divisor and show that it is difficult to do by the short method. Example: Divide 91,876 by 37. Here let the children see clearly what we are going to do,—to see how many times 37 will go in 91,876. I illustrate by supposing that we have 91,876 nuts to put equally into 37 bags, and that we wish to know how many must be put into each bag. Having placed the numbers in position for working, we proceed—

```
37)91876(2483 nuts in each bag.
   74
   ---
   178
   148
   ---
    307
    296
    ---
     116
     111
     ---
       5 nuts over.
```

There being no 37's in 9, we must take 91: 'How many 37's in 91?' Here I observe great diversity in the children's ability to answer. A sharp boy from previous drilling in mental arithmetic will reply: '2 and 17 over,' while the most stolid are utterly nonplussed. Having, after many remarks and questions, elicited that there are less than 3, we put 2 in the quotient. In multiplying by the 2, we place it under the divisor, till a little expertness in multiplying by a figure placed at a distance is attained. Having taken the 74 (which show clearly to the dullest child is twice 37) from 91, we have 17 left. As before remarked, several having worked it purely mentally, know that it is so far correct. Here it might be remarked to the children, that if all processes could be worked mentally and *remembered* as we go along, we should not require slates or paper to work on, and that these appliances are simply aids to the memory in long calculations. Now 37's in 178. This number is nearly twice as large as the previous one, 91, and more than twice as large as 74, which is twice 37. After considering the 178 in various phases, and with comparisons with what we have already done, the majority of a class will see that it must go 4 *or* 5 times. Try 5 times: 5 times 37 are 185, but the number we have is only 178; hence we see that it will not go 5 times. We now try 4 times, though a mentally lazy and inattentive boy would be as likely to say 'try *six*.' I would note here the difficulty of teaching a child who is mentally lazy, this laziness being often in inverse ratio to the amount of physical activity he can display. His bodily eye may see all you do, and you may congratulate yourself that he is really performing mentally the process going on before his eyes; but you are frequently wofully mistaken, as a little close questioning will convince you. Simple inattention, though trying to young teachers especially, may be more easily and successfully grappled with; but mental inactivity requires the teacher to be alert with countless devices to overcome it. Having taken 4 times 37 (148) from 178, we have 30 left. Now 37's in 307. This is much larger than either of the two previous numbers. Try 7 times, = 259, which, taken from 307, leaves 48. 'Will it go 7?' 'Yes;' 'No.' The more intelligent say, 'It will go more;' 'it will go 8.' Now show that we want to get *all* the complete 37's there are in 307;—we have taken 7, and there are 48 left; but there's another 37 in the 48, hence we get 8 times and 11 over. After trying 7 times with the 48 remainder, caution the children against saying it will now go once, and putting the 1 in the quotient after the 7; show that we must rub out all after the 307 and begin *de novo.* Now finish in the same manner, whatever the length of the sum, and show clearly what result we have got. We wanted to know how many nuts must be put equally into *each* of 37 bags, so that the bags may contain in all 91,876 nuts. We have found that each bag must contain 2483 nuts, and there are 5 nuts over—not another for *each* of the 37 bags. Explain well till the answer is clearly understood,—that we have found out what we really wanted to know—how many nuts for each bag.

At this stage the Pence Table is committed to memory, being extended to 1200 pence, and is much used in mental arithmetic in the more advanced stages. The mental arithmetic in this class (fourth) consists in drilling in larger simple numbers, in the Pence Table, and in easy prices of articles. The following are a few specimens of questions in a lesson in mental arithmetic here:—3 times 16, twice 48, twice 96, 192d.? 4 times 17, 3 times 68, 3 times 204, 612d.? £2, 19s. 4d. is how much short of £5? How much is 270d., 370d., 470d., 670d., 870d., etc.? 285d., 421d., 377d., 613d., 205d., 981d., 1080d., etc.?

How many fifteens in 100, in 183, in 200, etc.? 16's in 83, in 147, in 190, etc.? 5 lb. of beef at 9d. a lb., 6 lb. at 8½d., 10 lb. at 9½d., 15 lb. at 10½d., etc.? 4 lb. of butter at 11½d., 6 lb. at 1s. 2d., 9 lb. at 1s. 3d., 10 lb. at 1s. 2½d., etc.?

Having now gone through the *teaching* of the whole of the simple rules, a variety of exercises in *all* the simple rules, from addition to long division, is now given daily for some weeks or months,—from dictation, from the board, and from cards. Numeration and Notation are now extended to millions, the figures being carefully divided from the right by commas into groups of three figures each; thus, 80,071,040.

(*To be continued.*)

'How I teach Writing.'

BY JOSEPH COX,

Author of 'Practical Standard Copy-Books.'

WRITING consists in reproducing in ever-varying combinations a few elements. It renders effectual aid in the earlier stages of reading, and is an indispensable instrument in the acquisition of correct spelling; whilst it cultivates the eye, the hand, and the judgment, and is frequently the sole index, in the eyes of the parent, of the progress of his child.

The qualities of good writing are legibility, rapidity, and beauty. The more it is sloped, the less legible it becomes; and the more upright, the less rapid is the execution. There is a general tendency to slope it too much.

Let us suppose that we have before us a class of young children unable to write. What has to be taught? An alphabet consisting of twenty-six letters. But as each of these letters has two entirely distinct forms, capital and small, there are fifty-two letters to each. How can they best be taught? Take the small letters first, as they are learned the more easily. Can they be associated—arranged in groups, the letters in each group having something in common with that group? Evidently they may.

Before commencing work with the class, each scholar should be supplied with a sharpened pencil inserted in a pencil-holder, and slates of a good size ruled on one side with double lines about three-quarters of an inch apart, *and then a third line midway between the outer lines.** All these lines should be distinct and indelible. Similar lines should be ruled on the blackboard, of course farther apart than those on the slates. If possible, all the classes writing on slates should have desk accommodation.

I.—WRITING ON SLATE.

(*a*) **Small Letters.**—*Group* 1: *n, m, r, v.*—All the script characters are made up of *strokes* and *curves.* If these be well taught separately, and then the mode of joining them, we shall obtain good writing. The importance of *the third or middle line* will now be apparent. The making of straight strokes on slate, being so easy, may be dispensed with, and we can then at once proceed to teach the curve. Secure the attention of the class, and then commence *on the middle line* of the first set of lines on the blackboard and proceed to the top line, *exactly touching it,* making a good round curve, and then bringing the down stroke to the bottom line, thus forming the first part of the letter *n*. To excite the interest of the class and impress more vividly on their minds how it was made, call several children out and tell them to make one like it on the blackboard. They may then be allowed to make one for themselves, the teacher first carefully showing them how to hold their pencils. Great care should be taken to secure the making of a good curve, the teacher going round to each child and helping all unable to make one by taking hold of their hand and steadying it. All misshapen curves should be rubbed out, and another attempt made. Several more curves may then be made, all in one line. The almost general fault will be, making the curves too narrow and even pointed, failing to make them of uniform width, and either going above the top line or not touching the top and bottom line. To secure the making of curves of uniform width, the teacher should turn the slate upside down, and the child will then readily see which curves are too narrow; the child should afterwards be encouraged to do this for himself. A few curves of uneven width might also be written on the blackboard, the children being asked to point out the faults. Other curves might then be formed on the blackboard, some of them not exactly touching the top or bottom line, and the children's criticism asked on them.

The first lesson might well be spent in teaching the curve, the teacher throughout paying great attention to three points—(1) that all the pencils are held properly; (2) that all the curves are bold and round, and exactly touch the top and bottom line, none going above it; and (3) that each stroke be brought down to the bottom line and exactly touch it, while not going below it.

The second lesson might then be spent in teaching the second part of the letter *n*. Commence on the middle line of the blackboard, go up to the top line, make a good bold round curve touching the top line, as in the first lesson, and then bring the stroke down to the bottom line, forming another similar curve and finishing it on the middle line. The teacher should carefully see, throughout the lesson, to the three points mentioned above, giving careful *individual* attention to all the class. Let his motto at all these early stages be, 'Hasten slowly,' seeing that every *detail* is carefully carried out. As soon as each new copy is written on the board, at this as well as all subsequent stages, call on the class to give the name of the letter or word. The remainder of this lesson might then be occupied in teaching the letter *n* by joining the two parts already taught. The other letters of this group, viz. *m, r, v,* should be taught in the same manner, one lesson being spent on each, and in revising former lessons.

Group 2: *i, u, w, e.*—First teach the straight stroke and curve of the *i*, showing the class that it is merely the first part of the letter *n* turned upside down. Then teach them how to join the up-stroke to the *i*, *on the middle line.* The *u* and *w* will naturally follow, pointing out that the loop of the *e* should be commenced on the middle line and great care taken to have it properly formed. Form easy words such as *we* from this group.

Group 3: *l, b, t.*—In making the *l*, commence the same distance above the top line as the first and third lines are apart (three-quarters of an inch), and make the down-stroke and then a good curve ending on the middle line. Next join the up-stroke of the *l* to it on

the top line. The *t* should only go half the distance above the top line as the *l* and *b*, and should be crossed midway between the top of the *t* and the top line. Then form easy words into which the letters of this group enter.

Group 4 : *h, k, p.*—Care must be taken in making the curves of the *h* and *k* to see that all the class make the *top* curves of the same width as the bottom ones. Let them turn slates upside down and compare the width. The up-strokes of these letters should be joined on the top line, but the curves should join the down-stroke *on the middle line.*

Group 5 : *j, y, z, f.*—The loops of all these letters should go as far below the line as the *l* and *b* above the line. Great care should be taken in getting well-formed loops.

Group 6 : *c, o, a, d, g, q.*—This group consists of the *o* and its combinations. The *c* is taken first to prepare the way for making the *o*. In making the *o*, insist on the class commencing it *on the middle line, not* on the top line, and see that it is made sufficiently round and carefully joined. Next make the *o* into an *a*, pointing out most particularly that the down-stroke is commenced *on the top line* and *not* at the middle of the *o*; the down-stroke to touch the *o, but not to cut it.* Having taught the group, form words from it such as *dog.*

Group 7 : *s* and *x*.—The *s* will require careful teaching, the teacher seeing that it is made wide enough, and that the dot is brought round to the up-stroke. The *x* merely consists of an inverted *c* united to a second *c* in its natural position.

(*b*) **Capital Letters.**—These may all be conveniently arranged in four groups, and they may be written within the rules already ruled for the small letters.

Group 1 : *C, E, L, S, G, H, K.*—*C* is more easily made than any other letter; then follow the other letters *having the loop* like the *C*. Take special pains in getting a good curve for the *C*, as there are only six capital letters in which the curve does not occur. See that all the letters touch the top and bottom lines, except, of course, the bottom loop of the *G*.

Group 2 : *Q, V, Y, Z, X, O.*—The curves are made to fill the two top lines—a good guide for little children, and easily imitated. See that the curves are all bold and round, and of uniform size.

Group 3 : *I, J, T, F, A, N, M, W.*—The down-stroke and the curve of the *I* should be taught first; then the top of the letter could be added, as this method is easier for very young children.

Group 4 : *P, B, R, D.*—These four letters are all similar in construction, and will naturally follow each other. To prevent confusion between the capital and small letters, occasionally write them side by side on the blackboard, thus: *A, a ; B, b ;* and let the children read them aloud and afterwards write them on their slates; then require them to be written from memory; and, for the sake of variety, a whole word in capital letters, or words beginning with capitals, may be dictated, the class making the capitals fill the three lines ruled for capital letters, and the small letters the two lower of the three, thus affording practice in *round* hand. The slates, as now ruled, can thus be used on one side for *large* hand without capitals, and for *round* hand, each word beginning with a capital. Nothing but constant practice will give *freedom. If the large and round hand are not carefully taught, the teacher will strive in vain to secure a bold small hand.*

(*c*) **Figures and Mode of setting down Sums.**—The figures on slate should be made a little larger than those on paper, so that the teacher may be able the more easily to point out defects, and also to give freedom to the work of the children. Here again the blackboard should be used. Teach the figures one by one on the blackboard, and insist on exact imitation by all the class. As there are so few figures to teach, a teacher who tolerates a slovenly style is without excuse. All the figures should be of the same size except the *7* and the *9*, which should be half as large again as the rest. The up-stroke of the *1* should join it at the top; the *2* should be made exactly like capital *Q ;* the *3* open at the top and a well-formed curve at the bottom; the *4* a small loop at the tail, and then the line carried horizontally, the down-stroke cutting the horizontal line in the middle, and going as far below as above it; the *5* crossed at the top with a *straight* line and a good round curve at the bottom; the *6*, the curve half the length of the whole figure and the back slightly curved; the *7*, short down-stroke, then the curve taken from the middle of the down-stroke and the tail of the figure carried below the line of that part of the figure above the line; the *8* with a good curve at the top; the *9*, make a good *0 on* the line, *and the same size as the 8*, and then the tail as long as that of the *7*, giving a caution against the almost universal error of beginning *above* the cipher to make the tail. The figures having thus been taught in detail, practice should be given in setting down sums. Here the chief difficulty will be to get the children to put units exactly under units, tens under tens, etc. To overcome this difficulty, *and yet not puzzle the children with too many lines on their slates*, rule on all their slates a vertical line about an inch and a half from the right-hand side, and then draw with the chalk a similar line on the blackboard. Write the first line of figures on the blackboard, *placing the units on the vertical line*, and reminding them that all the figures must be of the same size, except the *7* and the *9*, and placed in a straight line across the slate, and well apart. Then in the second line of figures place the units on the vertical line under those in the first line, and the tens exactly under the tens in the first line, seeing that all the class keep the lines of tens and hundreds, etc., as straight as the line of units. When the sum is put down, let all the class rule the line separating the sum from the answer, taking care that the line does not touch any of the figures except the tails of the *7* and the *9*; draw the line a little beyond the figures on the left-hand side so that it may be level with the lines underlining the answer, and rule two lines under the answer *exactly* the same length as the one above the answer. A similar course is followed with the remaining sums, which are placed exactly under the first sum. Thus a very valuable training will be afforded *in preparing them to put their Arithmetic on paper.*

(*d*) **Small Hand and Transcription.**—Rule the other side of the slates with double lines about one-fifth of an inch apart. After the previous drill in large and round hand, we have now only to teach the letter *r* and the *five* loop letters which have not been already taught. Rule double lines on the blackboard with chalk, and commence on the bottom line with

the up-stroke of the *r*, carry it above the top line to make the dot of the *r*, then come down again to the top line and go straight along the line till you get the width of the *r*, then down to the bottom line again and make the curve of the *r*. In practice this method of teaching the *r* will be found extremely easy and effective. Next teach the five letters *l*, *b*, *h*, *k*, and *f*. Begin with the *l* as it is the easiest, and be careful to insist on all the class commencing the loop of the *l* *on the upper line*, *not* below it. The *b* will then easily follow, and the loop of the *h* and *k*. The next point of importance is to see the children commence the second part of the *h* and *k* *midway between the two double lines*, thus entirely preventing this part from running into the loop, which is a very common and ugly defect. As each letter is thus carefully taught, write the letter five or six times in a line on the blackboard and require the class to copy them, the teacher taking care that all the loops are of uniform length and width. Simple words may then be formed containing the loop letters, and the class write them, first from a copy on the blackboard, and then from dictation, the teacher carefully inspecting every slate and every letter. Special practice in writing the *r* and the loop letters, including not merely the five above but all those learnt before, such as the *g*, *y*, *j*, etc., should be given at stated intervals to keep the writing exact.

The next step will be for the teacher to select a short paragraph from the reading-book of the class and write it one word at a time on the blackboard, specially calling the attention of the class to the rule requiring that every sentence should begin with a capital letter. The class should show slates after writing each word, and the teacher carefully inspect each slate, pointing out misshapen letters and insisting on their correction *before he goes on to the next word*. Here again remember the injunction, 'Hasten slowly.' When an error is general, draw the attention of the whole class to it on the blackboard. Always require the children to repeat the word as soon as it is first written on the blackboard. When the short copy has been thus written one word at a time, turn the blackboard, tell the class to rub out the copy, give the children reading-books, tell them to copy the passage, and, when written, turn round the blackboard and let them compare their work with the copy, and see they make the necessary corrections, especially noticing the *spelling*. The common faults at this stage are: omission of small words and of final *s* and *d*; the substitution of one letter for another, as *n* for *m*; substitution of capital for small letters, and *vice versa*; neglect to join letters.

Transcription from reading-books without previous preparation will follow, *dictation* being, if possible, preceded by transcription. Thus transcription might be given as part of the Home Lesson for the previous night, but it should always be carefully examined, and mistakes written out by the children. The passage might then be given from dictation in school *after the following preparation*.

(*e*) **Dictation.**—If the class is very young, write the passage on the blackboard, and let the children spell all the difficult words together, and then singly; turn the blackboard, and ask them to spell one word at a time, or better still, let them write the words on their slates from dictation. In the higher classes, it would be sufficient to write the most difficult words on the blackboard, and spell them over with the class. The teacher should constantly bear in mind that as spelling is learnt mainly by the *eye*, to give a dictation lesson without due preparation is simply to confirm the bad spelling of the class, and thus do much harm. When thus carefully prepared, no scholar should have more than one or two mistakes in a piece of ordinary length.

Before commencing the dictation, the teacher should remind the class that *words* omitted, inserted, or substituted for another word, or *letters* omitted or added at the end of a word, will be considered errors: he should give directions respecting the *I* and the *O* when written alone; distance of words from each other (nearly a quarter of an inch); the use of capitals; leaving a margin on left-hand side of slate, etc. Then give out the first portion *twice*, slowly and distinctly, no scholar being allowed to begin writing until it is thus twice repeated, and if any one then fails to hear, to put up hand and ask, *but on no account* should they be allowed to omit words or fall behind the rest of the class. The children should always be carefully separated, *to make copying almost impossible.* Whilst the dictation is proceeding, a sharp eye should be kept on the class to detect the slightest attempt at copying, and to do this he should remain almost the whole time in front of the class, occasionally, however, going round to see that none are falling behind or doing careless work. Generally the writing of a dictation lesson is expected to be done as a model, but occasionally it is desirable to require them to write more quickly, especially in the higher classes.

Next comes the correction. Give the class a few sums to work, whilst the teacher, assisted by a few elder boys from the first class, examines each slate, and writes each word correctly over the misspelt word, which is then written out by the scholar a given number of times. When all the slates are examined, the teacher writes all the misspelt words on the blackboard, each syllable divided by a hyphen, and the class spell them together, pronouncing each syllable separately. The blackboard is then turned, and the words are dictated, all being now expected to write them correctly. All the slates are then shown, and the writing is criticised. A list of the misspelt words should be entered in a book, and dictated occasionally. The children in Standards I. and II. should always write between double lines.

II.—WRITING ON PAPER.

(*a*) **Copy-Books.**—It is of the utmost importance that the teacher should use a good series of copy-books. Some of the best published are the Public School Series, Line upon Line, and Vere Foster's. Nearly all the series commence with round instead of large hand. The writer of this paper has drawn up a series of copy-books, 'Practical Standard Copy-Books' (Hughes), on the system here advocated, and believing that it is of material service, especially to a young teacher, to know what books should be used at different stages of the learner's progress, he will now proceed to give such information.

Nos. 1, 2, 3 are all medium large hand, provided with the middle line to aid both the scholar and teacher, no letters being used in the copies which go above or below the line. Great stress is laid on a solid and uniform down-stroke; touching the top and the bottom line; the mode of forming the more diffi-

cult letters, such as the *e*, *o*, and *a*, by practical directions printed on the top of each page. These three books should be used until the scholars can make good down-strokes, and round, bold, and well-shapen letters. *No child should be allowed to have a copy-book until he can write a good large hand on slate.*

No. 4 consists of short common words in text hand, the middle line is dispensed with, and the letters, which go above and below the line, are systematically taught.

No. 5 is round hand, the copies consisting of common words, each of which commences with a capital. Special practice is given in making capitals. *Children should on no account be permitted to begin small hand until they can write the large and round hand well.*

Nos. 6, 7, and 8 are initiatory small hand in double lines. No. 6 first gives special practice in making the small hand *r*, and the *l*, *b*, *h*, *k*, and *f*; but the special feature of the book is the thorough *training given in setting down the Arithmetic of Standard II. on paper*, on the same plan as that described in the first part of this paper for working sums on slate.

No. 7 consists of narrative from Charles Kingsley, in double lines of the same width as No. 6; and No. 8 has double lines somewhat narrower than Nos. 6 and 7, but the distinctive feature is the *practice given in setting down the Arithmetic of Standard III.* Scholars should not be permitted to leave the double lines until they can write a firm and uniform hand.

Nos. 9 to 15 are single-lined small hand, the copies being narrative, grammatical, or geographical, in a good bold round hand, gradually decreasing in size as the higher numbers are reached. In these seven books a great variety of practice is afforded.

Mechanical aids in copy-books, when too numerous or too long continued, only cramp the handwriting: the double lines should be dispensed with as soon as the scholar can write an even and firm hand. If he begins to write a small, scratchy, uneven hand when using copy-books with single lines, he should be put back again into double lines for a time. When writing on single lines, the constant tendency is for the writing to become too small and uneven; the teacher should therefore insist on its being as large, and the down-strokes as thick as the copy. There is also a tendency to make the loop letters too short.

Copy-books are a good indication of the character of a school, hence H.M. Inspector is wisely required to see them at his annual examination.

(*b*) **Writing Lesson in Copy-Books.**—When the class is seated, arrange the children at equal distances in the desks, so as to give ample space to each, *placing the worst writers, and those who are writing for the first time on paper, in the front line*, so that extra help and superintendence may be given them. Then the class being supplied with pens and books, give the orders 'Open books,' 'Show pens,' holding their pens ready for writing, the teacher of course seeing that all the pens are held properly,—whether the fingers are placed too near the nib or too far away; pointing the pen across the room, and *not* at their next neighbour; holding it too upright, or too much inclined. Next give a glance at the position of the books on the desks; see that each scholar sits up a little to the *left* of his book, *not* exactly in front. Then give the order to begin writing by saying, 'First line,' cautioning them not to dip pens too deep, or shake out the ink on the furniture or the floor. Whilst they are writing, keep a special eye on the worst writers, and show the beginners how to hold their pens. Also watch the whole class, and check the tendency to sprawl with the left elbow across the desk, or to rest the left ear on the arm. The rapid writers should be checked, and the slow ones hastened a little. When the first line is written, the whole class should show books at the word of command. In inspecting the books, notice if any of the down-strokes have ragged edges, *or* are thin, whilst the bottom curves are thick; be sure such scholars have held their pens on one side, and see they hold them properly during the writing of the next line. *If any general faults are observed, they should be pointed out on the blackboard before the next line is written.*

Then give the order, 'Second line,' and whilst it is being written the teacher should get round the class *and mark all misshapen letters or other faults* with a lead pencil, or better still, a coloured pencil. If time permits, he should occasionally pencil out a few letters, and, in the case of beginners or very bad writers, steady and guide their hand to give them confidence, *but he should never sit down and write half a line or a line whilst the class is left to take care of itself.* The second line is then inspected like the first, the teacher pointing out the faults either to each individual scholar or on the blackboard, if necessary. The order for the next line is then given, and so on through the lesson, sometimes allowing them to write *two* lines at a time, the teacher keeping as much as possible in front of the class, and insisting on all sitting in the right posture, and holding pens properly, and yet not neglecting to go round the class at regular intervals to mark faults.

The common faults in writing large hand are not making uniformly thick down-strokes, the tendency being to make them too light, rarely too heavy, and not touching the top and bottom line. On the other hand, when first attempting small hand, the down-strokes are generally too heavy. The best writers, whose hands are already formed, should be allowed to copy poetry or prose from standard authors into their exercise books.

(*c*) **Dictation on Paper.**—The plan of giving a dictation lesson on slate has been already described. When the scholar has reached Standard IV., less time may be given to copy-book writing, and more to dictation on paper. But if the writing in copy-books be too much neglected, it quickly becomes small, uneven, and slovenly; and if there is too little practice of dictation on paper, the children are at a loss to arrange what they have to write, and write too slowly. Dictation on *slate* should never be given to the higher standards, except when the desks are not at liberty, and a fair pace in writing should be insisted on. See that the capital letters are well made, and the words not crowded into each other.

(*d*) **Arithmetic on Paper.**—The practice already given in setting down sums on slate, and the aid given by Cox's Copy-Books, Nos. 6 and 8, in the Arithmetic of Standards II. and III., are excellent helps in training the children to work their arithmetic on paper. Occasional lessons are also given to Standards III. and IV. by placing the sums on the blackboard, line by line, and then the class copying them on foolscap, the teacher taking care that the sums are placed in *the middle of the paper;* the general tendency is to place them too near the margin on the left-hand side

of the paper. We also give directions for the dots separating the figures to be small and placed *on* the line, that the figures be not crowded together, and that they be placed exactly under each other. The ruling is then carefully superintended, and a caution given not to make the lines too heavy.

During the last nine months of the school year we give Standards III. to VI. sums in arithmetic to work *on paper* as part of the *Home Lesson* each night, after previously explaining the work in school, and they are required to set them down as carefully as if for the annual examination. Thus an abundance of *practice on paper* is given during the year.

(*e*) **Drawing.**—The teaching of Drawing materially improves the writing, especially the capital letters. It trains both the hand and the eye. As soon as the scholar has reached the Third Standard, he should commence drawing, first on slate, then on paper.

In conclusion, I would remark how essential it is that the teacher himself and all his pupil teachers should be good writers not only on paper but on the blackboard, and what a bad influence *scribbling on the blackboard* must necessarily have on the writing of the whole school. As the teacher writes, so will his scholars. ***The teacher himself should first endeavour to realize what constitutes excellence, and then try to raise his pupil teachers to the same standard.***

If each teacher were to pay particular attention to the writing of his pupil teachers on the blackboard during the first year of apprenticeship, he would be amply rewarded by the superior finish which they would bestow on the writing of the whole school.

This completes the outline of the system which we employ in the teaching of writing. Some may perhaps ask, 'Why go into all these details?' To these I would reply, 'If excellence in writing is desired, *minute details must be attended to.*' Good plans and plodding hard work are equally essential. Let each teacher cherish within him a perpetual striving after excellence.

—o—

How I teach Geography.

BY A. PARK, F.R.G.S., F.E.I.S., ETC.,

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TO the natives of the British Islands, whose mercantile marine are the recognised *carriers* on the ocean, whose *white sails* dot the seas surrounding almost every land, and upon whose colonial and foreign possessions the sun never sets, geography—historical, commercial, and political—ought to be invested with the very deepest interest.

As a nation, our agricultural productions are of secondary importance; our dependence for our national prosperity and well-being being mainly upon our vast manufacturing industries.

Seeing also that our production in this direction is immensely in excess of our home demands, we are, of necessity, constantly on the outlook for remunerative markets in other parts of the world, for the interchange of our manufactured commodities, so that an acquaintance with geography in respect to the situation and physical peculiarities of other lands,—the habits, customs, and special necessities of their inhabitants,—becomes of vital importance to us.

Not only, however, from this utilitarian point of view might instruction in geography in the primary as well as in the secondary schools of this country be insisted upon, but its importance as 'an interpretation of nature and art' in the intellectual training of the young could very easily be demonstrated. Undoubtedly the subject has long been taught as part of the ordinary curriculum in the great majority of the better class schools of the country, and in a large proportion of our elementary schools, for about a quarter of a century, but, we must candidly confess, with very indifferent success.

The causes of this may be very well set forth in the following comments made upon the subject by gentlemen who have had the most favourable opportunities for forming opinions on the matter:—'The teaching of geography is too mechanical; the memory is overburdened and the intelligence and imagination stunted by way of exercise and illustration.'

'Many teachers make the weary scholars learn by heart tedious strings of mere names and numbers, and are content with mechanical instruction and stereotyped sets of words; who work as if they and their scholars were machines and not reasonable beings.'

'Mere cram of a little text-book is, in too many cases, the sole preparation for the examination in geography.'

One gentleman of very wide experience, and of close observation, has lately remarked that in many schools which he has visited, 'the children have no more idea of a map than they have of the meaning of an Egyptian papyrus or an Assyrian cylinder.'

Whether this be an exaggeration or not, there is a general consensus of opinion on the part of Her Majesty's Inspectors of Schools, and the Examiners in connection with the Oxford and Cambridge Local Examinations, that the subject of geography seems to be very badly, because uninterestingly and unintelligently, taught.

No little discussion has taken place lately, especially among elementary teachers, respecting the wisdom and justice of the Education Department in insisting on what are technically known as the 'Class Subjects' (of which geography is the one most commonly selected) being taught through 'Reading Lessons.'

Into the merits of the question it does not fall within the scope and purpose of this article to enter.

We fear, however, and not without justice, that the representations made to the Department by those officers whose duty it is to report on the state of the elementary education in the country, have clearly demonstrated that some change in the way in which geography and the Class Subjects have been taught has become a matter of absolute necessity.

The very books, these gentlemen urge, which have been employed for instruction in geography, and the manner in which they have been utilized by the teacher, demand reform.

Cheap little penny and twopenny pamphlets are in general use in such schools; the lists of words, names, and definitions are learnt by heart, and said by rote, without any exercise of what Professor Bain describes as 'the conceiving power, grounded on distinct lines of observation and experience.'

These little works are, in the incisive language of

the *Saturday Review*, described as 'the tinned meat of the intellectual life' usurping the place of the fresh, vigorous, and graphic preparations.

'Geography,' says Mr. Moseley in his Report to the Privy Council on Education in 1845, 'acquires its full value as a branch of education only when it loses the character of an accumulation of facts, undigested by the child's mind, but heaped up in his memory, linked by no association with the world of thought and of action which immediately surrounds it, or with that which is within it.

'Tell the child to observe the lines of the map which hangs perpetually before his eyes, and talk to him only of the *names* of the places indicated upon it, and you will soon weary his attention; but speak to him of the men who inhabit any of these places, tell him of their stature, and aspect, and dress, and ways of life, and of their forms of worship,—speak of the climate of that country, of the forms of vegetable and animal life with which his eye would be conversant if he dwelt there; of the trees and flowers that grow there, and of the birds and beasts, —and you will carry his interest with you.'

We have said this much by way of introduction, because it very fairly represents the views we entertain on the subject, and the general principles by which we have been guided in imparting instruction in geography, with, what we believe, fair success, for upwards of twenty years.

FIRST LESSONS.

Notwithstanding the opinion of Professor Bain, who considers Object Lessons hardly adequate as a means of introducing the elements of geography to children of eight or nine years of age, our experience goes to show that *informal* lessons on 'sunshine and rain, heat and cold, snow and ice, for conceiving where the hottest days at home are the constant fact; and, again, in other portions of the earth, where ice and snow endure three parts of the year,' are very valuable helps as early introductory lessons on the subject.

Our habit has been—so soon as the children come to us from the infant room, where they have been well exercised in form and colour, and have been taught 'to point out the appearance or sensible qualities of an object, and to specify its uses'—to introduce the pupils to the field of natural history, and to cultivate their observing powers.

The suggestions made by Mr. Moseley in the Report to which we have already referred, we have found of great value at this stage. He advocates that the child should be made acquainted 'with the characteristic features of that portion of the earth's surface which is within the compass of a day's journey, its varieties of elevation and aspect, its hills, valleys, and streams; and his attention directed to the agrarian divisions of his parish, and the fields and holdings which unite to form it. The boundaries of these, with which his memory is familiar, will convey to him the first idea of a map and its uses.' All this is not the work of a day, or even of a week, but must be carefully and judiciously *dealt* out piece by piece to the young people.

It is in these early stages that the *experienced* teacher is of great value; and to leave this part of the work for its logical and successful treatment to the junior assistant or the pupil teacher, is morally certain to lead to failure. This is what is known as the '*Synthetical System*,' as opposed to the '*Analytical*,' which sets out with general views of the entire surface of the earth, and gradually descends to one's own neighbourhood.

Into the comparative merits of the two systems we do not at present enter, but the reader will find the subject very fairly and very interestingly discussed by Mr. Robinson, of the Irish Inspectorate, in his excellent treatise on *Method and Organization*.

It matters little which system is adopted. One thing seems tolerably clear to our mind: we are bound to employ to a greater or less extent what may be called the *topographical* system at the very threshold of the subject. That is to say, as Mr. Robinson puts it, 'the terms *city*, *country*, *continent*, *river*, *mountain*, etc., do not in general convey correct ideas of the things themselves to the minds of the children; and hence we must appeal to topography first, not as a system of teaching, but only as a means of explanation of certain terms.' Professor Bain would call this 'concrete realization,' and would be disposed to doubt the possibility of many parts of England—for example, the eastern counties, flat and monotonous—affording material for geographical conceptions. This is undoubtedly true, but we have now the most valuable helps to the teaching of geography, such as *models*, *sketches*, *pictorial views*, etc.; but better still, we have the way open to us of constructing clay models, etc., before the very eyes of the children.

HOW CAN CLAY MODELS BE UTILIZED FOR INSTRUCTION IN GEOGRAPHY?

The method we recommend is to have a table placed before a class—a junior class, of course—on which a quantity of soft clay and sand is placed. If, for example, it were desired to give the children an idea of a volcano, nothing would be easier than for the teacher to construct a model of one from the clay, and, while proceeding with this, explaining step by step at the same time, and in simple language, the gradual growth of the volcano from its early beginnings until it reached its giant proportions—why it has a *conical* shape—why a *cup-like* depression at its summit—the nature and character of the rocks on its sides, encouraging, at the same time, the children to put any kind of question to the teacher which their naturally playful and inquisitive imagination might suggest. The rough model of the volcano having been constructed before the eyes of the children in the way I have indicated, the employment of some simple piece of *fireworks* might well illustrate the *eruptions* which give the distinctive name to this kind of mountain.

With clay, also, the *hills*, *valleys*, *plains*, etc., could be appreciably illustrated even to the very youngest children.

To teach geography in the *early stages* simply by *definition* without familiar and appropriate illustration is, as Herbert Spencer properly remarks, 'wholly at variance with the method of nature, as exhibited alike in infancy and in the course of civilisation.'

Excellent sheets of *familiar illustrations* are also published by Messrs. Keith Johnston of Edinburgh; Reynolds; and Murby of London, and other firms

throughout the country, which are very useful at this stage.

Lately, however, cheap *raised maps*, illustrating capes, mountains, rivers, and the physical surface of various countries, have found their way into England from Germany, where geography has been taught for many years with singular ability and success.

To depend upon mere *verbal definition*, is 'not to teach the child how to observe, but to make it the mere recipient of another's observation—a proceeding which weakens rather than strengthens its powers of self-instruction, which deprives it of the pleasures resulting from successful activity, and is certain to generate indifference and even disgust towards' the subject of geography.

Formal and *verbal* definition must of necessity be given, and insisted upon being committed to memory, but these definitions must be wholly dependent upon the intelligent appreciation of that which is defined.

ASTRONOMICAL GEOGRAPHY.

To what extent should it be taught to young children? We have raised this question in order to direct attention in a sentence or two to the 'Standard of Examination' prescribed by the Education Department in the 'Code' for pupils of the Second Standard, or in other words, for children whose average age is between eight and nine.

The Syllabus runs thus:—'*Definitions, points of compass, form and motions of earth, the meaning of a map.*' Experienced teachers and the foremost educationists in the country are now pretty well agreed that the course of study laid down here is, in some aspects of it, quite beyond the grasp of children of the age for whom it is prescribed.

The 'points of the compass' and the 'form and motions of earth' cannot be taught with any reasonable measure of intelligent apprehension to young people until their minds are more expanded by age and discipline.

These two subjects of the Syllabus might be *thrown in* at a higher stage, and some additional portion of *descriptive* geography might very well take their place. If, however, the earth considered as a *planet* must be brought under the consideration of young people of this age, such *artificial* aids as the *tellurium*, the *orrery*, and other mechanical appliances which can now be obtained very readily from several London publishers, must be called most liberally into requisition.

Even with all the aid which can be obtained from the very best of these, the results, so far as an intelligent grasp of the matter is concerned, are far from being satisfactory.

We have found the use of a 'magic lantern,' in which *slides* exhibiting the causes of day and night, the rotundity of the earth, etc., are employed, to be of very great service at this stage, and an occasional evening meeting with the children in this way during the winter has been productive of much good to parents and children alike.

A RIVER AND RIVER SYSTEMS.

The manner in which we would treat this part of the Syllabus for junior children will pretty fairly represent the particular *method* which we would advise should be followed with other parts of the subject of equal importance.

We have in our own personal teaching very closely followed the lines laid down by Professor Bain in his work on *Education as a Science*, who remarks: 'The main lesson in the geography scheme is to conceive the visible aspect of the flowing waters, in the main stream and in all its branches, from the first rills emerging out of the oozy hill-tops and hill-sides.' We have likewise endeavoured—a course also approved by Professor Bain—to bring before the children's minds a 'visible picture of a river tree, as if from a bird's-eye view of its entire basin,' sketching out its tributaries, rivulets, brooks, and cascades,—not omitting, of course, the hills and valleys, and their relations to the stream, the 'connection of rivers with towns,' and the manner in which they minister to the comfort and healthfulness of the people.

By employing question and answer, and frequent repetition, we have here materials on the 'river and the river basin' sufficient for many lessons to the undoubted development of the intelligence and increased interest of the children.

Familiar and homely illustrations can always be used with advantage at this stage.

Mr. Steele, one of Her Majesty's Inspectors of Schools, appropriately observes in a Report to the Privy Council on Education: 'I have seen Preston boys receive quite a new sensation on being told that when they walked up the river and saw the Darwen run into the Ribble, they had before them what the geography books described in mystic terms as a tributary and a confluence.' Still further, to relieve the monotony of dryness and mere 'verbal memory,' Professor Bain suggests that poetry might now and then be brought to the aid of the 'geographical concrete,' and Tennyson's *Brook*, for example, might be read aloud to a class, as exhibiting in a fascinating form 'one of the numerous affluents of a mighty river.'

We think we have sufficiently indicated the manner in which we are in the habit of introducing our younger children to the study of geography.

It may be thought, perhaps, that we have dwelt at too great a length upon this part of our subject, but our experience has shown that everything depends upon intelligent principles in the earlier stages of instruction if real success is to be expected and attained.

GENERAL OR DESCRIPTIVE GEOGRAPHY.

When our pupils enter upon the study of a country, our practice has been to prescribe a certain amount of task-work to be learned at home from a text-book, and to insist upon its being well prepared.

'At all stages of geography,' says Professor Bain, 'local situation, form, magnitude, should be a distinct effort of memory, and should be held in the mind as visible facts, grounded on the map or model.'

Impressed with the truth of this, we first of all exercise the children in their various classes and in their various stages upon the portion of the lesson prescribed for each day's work with the map before them.

After the children have been made in this way *perfectly* familiar with the position, boundaries, magni-

tude, the general features of a country,—*i.e.* the rivers, valleys, mountain-ranges, plains, coast-line, etc.,—the situation of the towns, an account of the inhabitants, of the vegetable, animal, and mineral productions, and the industries of the country follow in natural sequence.

Skeleton Maps.—Each class ought to be provided with a skeleton map, and when the children have been well *drilled* upon the physical features of a country from an ordinary wall map, the skeleton one ought regularly to be used in testing their knowledge. In other words, the *ordinary* map is employed for *teaching* geography, the *skeleton* map for *examining* upon it.

The Blackboard and Geography Lesson.—We fear the blackboard is not so frequently employed in giving instruction in geography as it ought to be. Even in the early stages it could be used with much advantage.

(1) Our plan is to place the map and the blackboard alongside each other, and, bit by bit, to fill in the outlines of a country, employing question and answer as we proceed.

(2) To trace the courses of the rivers and the ranges of mountains in the same way.

(3) To require the children to *dot* in the situation of the chief towns, learning at the same time the countries, or counties, to which they belong.

(4) In more advanced stages the pupils should be required, under similar conditions of knowledge, to sketch the outlines, trace the courses of the rivers, etc, of any country with a piece of chalk on the blackboard, each scholar being required to complete a small portion without any aid from the map.

This plan of examination is certain to secure the attention of the class, and by this method of repetition and reproduction the information conveyed is more firmly fixed in their minds.

Suggestions as to teaching Geographical Names. — In all instruction in geography, it is absolutely necessary that the names of places, etc., should be taught; but as Mr. Robinson, to whom we have previously referred, observes, 'instead of teaching the names by themselves, they shall be joined with everything which will create in the minds of the children an interest and a pleasure, so that, thus associated, they may be permanently remembered.'

This remark very fitly expresses the lines on which we have proceeded, especially with our pupils who had entered on the study of *descriptive* geography, and we can testify to the great pleasure and interest which have been produced by the practice even among comparatively young children. It was first suggested to us in one of the very earliest issues of the *Minutes of Council*,[1] in which the whole subject was discussed with more than ordinary ability, and we are therefore tempted to give an extract from the same:—'The *names* may be made interesting by an attention to their derivation. In fact, "the *Etymology* of geographical names forms an important feature in this branch of knowledge. The name of a place often tells its condition or history; and the explanation of the same, by calling into exercise the power of association, increases the probability of its being remembered. Thus the name *Buenos Ayres* still shows the salubrity of the *air* of that town; *Sierra*, the Spanish name for a range of hills, the *saw*-like appearance which it presents; New *York* tells us that it was once a colony of *England*, and those who know that it was first called New *Amsterdam* know, too, that it was founded by the *Dutch*; *Virginia* shows that it was colonised in the reign of our *virgin* queen, Elizabeth; *Carolina*, during that of Charles (*Carolus*). The term *fell*, applied to mountains in the north of England, the south of Scotland, and to the islands of the north and west, shows that these parts of the country were occupied by some tribe or tribes of Scandinavian origin; while *ben*, or *pen*, found in the most mountainous regions, confirms the facts of history, that these high grounds were unconquered by the northern invaders, and continued in possession of the original Celtic inhabitants. In thus finding out the cause of the name, the reason has been exercised, and the study rendered highly philosophical; and a science which has often been thought to consist only of lists of hard unmeaning words, has been made attractive in a more than usual degree."'—The subject could be pursued to a very great length, and we recommend Isaac Taylor's work on *Words and Places* as affording great assistance to the teacher in the preparation of his work for class instruction in geography.

It may not be out of place here to observe that great care should be exercised by the teacher to consult the very best dictionaries dealing with the question of the pronunciation of *geographical* names.

[1] *Minutes of Council*, 1846–47, vol. ii. p. 356.

CONCLUDING SUGGESTIONS RESPECTING CLASS INSTRUCTION IN GEOGRAPHY.

These may best be given in the form of hints which our *experience* suggests.

(1) *The teacher ought to know the subject on which he is giving instruction well, and teach without the use of a text-book in his hand.* No possible excuse can be allowed for any teacher who does not attempt to arouse the attention and excite the interest of his scholars while conducting a lesson on geography. Books of travel—most pleasantly and agreeably written—and lively narratives of tourists are to be found in every library, and on every bookstall; and if the teacher were only to make a liberal use of the information he could cull from these, greater freshness and life would be imparted to his teaching. 'The description of a country like Switzerland, for instance, its mountains, lakes, plains, glaciers, waterfalls, avalanches, smiling valleys, and eternal snows, all accompanied by a proper map, and a description of the habits and governments of the people, would certainly do far more to instruct the mind than a catalogue of boundaries and divisions, involving a number of names to which no mental imagery whatever is attached.'

(2) *From an outline or skeleton map of a country, try to deduce the situation of the principal cities and towns, etc.* This is one of the best tests which can be applied with respect to the *manner* in which our instruction in geography has been imparted.

Nothing could better ascertain whether the intelli-

gence has been quickened and the reasoning powers cultivated.

Mr. Robinson, with much tact and judgment, puts the case thus:—'Certain conditions are given, from which certain consequences are to be inferred. Thus they are expected to discover that the rivers of Eastern Europe are slow, and of Western Europe rapid; after having been told that the former have their rise at a slight elevation, and have a lengthened course; and the latter originate in the high land of Central Europe, at no great distance from the sea. Political and social geography are thus shown to be in a great degree dependent on physical geography: the reason is seen why one country is agricultural and another commercial; why a certain manufacture should be carried on in a particular locality in preference to every other; and why an alteration in the mode of manufacture should involve a change in its seat. Thus, that Holland is agricultural, and England manufacturing; that our cotton manufacture is carried on in South Lancashire and the edges of the neighbouring counties, and not in Lincolnshire; that our manufactures generally are travelling north and west; and that iron, which was once largely manufactured in Kent and Sussex, is now only smelted on the great coalfields, are not merely so many facts, but highly interesting facts, because regarded as effects the causes of which are perceived, and have probably been discovered by the student himself.'

(3) *Encourage the scholar to draw maps of different countries with care and taste.* Professor Bain remarks that 'the drawing of maps impresses a country, just as copying a passage in a book impresses the author's language and meaning. In those cases where drawing is followed out as a fascination, it carries with it an interest in the face of nature, and an enhanced power of conceiving the pictorial aspects of the world.'

(4) *Train the scholars, especially in the senior classes, to write out in the form of an Essay descriptive accounts of a country, such as its river systems, mountains, productions, etc.* This is a very valuable exercise not merely in obtaining a fair idea of the knowledge which the scholar may have of the subject, but it is likewise a valuable exercise in acquiring the power of composition.

Lastly, *see that the teacher's own mind is full of the subject, and let him endeavour to acquire the use of pleasing and attractive language in class instruction.* To teach geography well, and with the success which ought to attend it, the teacher ought to remember that it requires a great deal of general knowledge, and this can easily be obtained by careful reading.

'A real knowledge of geography,' says Dr. Arnold, 'embraces at once a knowledge of the earth and of the dwellings of man upon it. It stretches out one hand to history, the other to geology and physiology. It is just that part of the dominion of knowledge where the student of physical and of moral science meet together.'

Recent Inspection Questions in Geography.

STANDARD III.

(1) Name a seaport in South England.
(2) Name the rivers of Pembrokeshire.
(3) What county touches Pembrokeshire?
(4) Name the chief openings connected with the North Sea.
(5) What strait is connected with the English Channel?
(6) What large county touches the North Sea?
(7) Name a seaport in Lancashire.
(8) Name a seaport in South Wales.

STANDARD IV.

(1) Where is India?
(2) What is a peninsula?
(3) Name the chief towns in India.
(4) Name a large island near India.
(5) Name one of the divisions of India.
(6) Where is Madras?—Bombay?
(7) Where are the Himalayas?
(8) Name the chief peaks in the Himalayas.
(9) What is the highest mountain in Great Britain?
(10) What is the largest lake in the British Isles?
(11) What is the largest town in Scotland?
(12) On what does it stand?
(13) What counties touch the North Sea?—English Channel?
(14) Name the chief openings on the west coast of Ireland?

STANDARD V.

(1) Give the boundaries of Europe.
(2) How many continents are there besides Europe?
(3) What is the most important country in Europe?
(5) Why is Great Britain the most important, for it has not the greatest number of soldiers?
(6) What countries or empires have the greatest number of soldiers?
(7) What is the Emperor of Russia called?
(8) Where does he live?
(9) What is the King of Turkey called?
(10) Where does he live?
(11) What is the Sultan's wife called?
(12) In going from Athens to the Black Sea, what sea do you pass?
(13) What is an archipelago?
(14) Name the largest island in the Archipelago.
(15) Name some other islands on the east of Greece.
(16) What are those islands on the east of Greece called?
(17) What countries of Europe have been at war recently?
(18) Where is the Gulf of Ægina?
(19) Name some towns in Greece besides Athens.
(20) What is there at Corinth besides a town?
(21) What river of importance runs through Russia into the Caspian?
(22) What town stands at the mouth of the Volga?
(23) Name some other towns in Russia.
(24) Where is Archangel?

Pupil Teacher's Examination Questions.

JANUARY 1881.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the value of 694 cwt. 1 qr. 14½ lbs. at £3, 19s. 4d. per cwt.

2. If the tax on £335, 7s. 6d. amounts to £58, 13s. 9¾d., what is that in the pound?

3. A besieged town containing 22,400 inhabitants has provisions to last for three weeks; how many must be sent away in order that the city may hold out for seven weeks?

4. A ceremony attended by a number of persons from a distance extends over 2 days. The first day the railway conveys 285 first-class and 3085 third-class passengers, charging 2s. 8d. for each of the former, and 1s. 7½d. for each of the latter. The second day, in hopes of larger receipts, the railway issues tickets at the uniform price of 1s., and conveys 6009 passengers. Find the difference in the sums taken on the first and on the second day.

FEMALES.

1. Find, by practice, the value of eighty dozen pairs of boots at 19s. 7½d. per pair.

2. Find the value of 1527 cwt. 2 qrs. 16 lbs. of sugar at 3½ guineas a cwt.

3. Make out a bill for the following:—

62½ tons of hay at £3, 15s. per ton.
41¼ qrs. of beans at £2, 2s. per qr.
58¾ qrs. of oats at £1, 6s. per qr.
25 sacks of flour at £1, 7s. 6d. per sack.
37½ tons of potatoes at £4, 2s. 6d. per ton.

4. Find the rent for 61 months 1 week 4 days at £3, 0s. 6d. per month of 4 weeks.

Grammar.

1. Parse all the verbs and adjectives in the following:—

'It is sad to see an infant fade
Beneath our very gaze,
As a lily in some poisonous shade,
Droops, withers, and decays;
It is sad to see the eye's pure light
Grow fainter day by day.'

2. Plurals are sometimes formed from the singular by a change in the body of the word. Give examples of this.

3. Adjectives of number are sometimes used as adjectives, sometimes as nouns. Give examples of each.

Geography.

1. Mention the different names given to openings in the land, and to narrow passages of water on the coasts of Great Britain and Ireland; and give examples of the use of each term, describing exactly where each of them is.

2. Trace minutely the line of *water-parting* which separates the basins of the Thames and Severn from those of rivers flowing into the English Channel, and mention these rivers in order.

3. Say what you know about the Orkneys and Shetlands, the Hebrides, the Isle of Man, Anglesey, the Isle of Wight, and the Channel Islands.

Draw a map, *if you can*, in illustration of any one of your answers.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Versatility.*

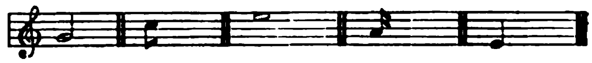
Write, in small hand, as a specimen of copy-setting, '*Stirred up by Dorset, Buckingham, and Morton, he comes.*'

Music.

A quarter of an hour allowed for this paper.

1. Write over each of the following notes its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other):—

2. Follow each of these notes by its corresponding rest:—



3. How many tones and semitones are found in a major scale, and what are the places of the latter?

ANSWERS.—CANDIDATES.

Arithmetic.

MALES.

1.

	£	s.	d.	
	3	19	4	
			694	
	2752	17	4	=value of 694 cwts.
1 qr.=¼ of 1 cwt.		19	10	= ,, 1 qr.
14 lbs.=½ of 1 qr.		9	11	= ,, 14 lbs.
½ lb.=$\frac{1}{28}$ of 14 lbs.			4¼	= ,, ½ lb.
	£2754	7	5¼	=value of 694 cwt., etc.

2. £345, 17s. 6d. : £1 :: £58, 13s. 9¾d. : 3s. 6d. Ans.
Or, tax on £335, 17s. 6d.=£58, 13s. 9¾d.
,, £1 =£58, 13s. 9¾d.÷£335⅞
$=\frac{56343\text{d.}}{335\frac{7}{8}\text{d.}}=$ 3s. 6d. Ans.

3. 7 weeks : 3 weeks :: 22400 inhabitants.
$\frac{22400\times 3}{7}=9600$,,
Therefore 12800 must be sent away.

4.

	£	s.	d.	
285 at 2s. 8d.=	38	0	0	
3085 at 1s. 7½d.=	250	13	1½	
	288	13	1½	total for 1st day.
6009 at 1s.=	300	9	0	,, 2d ,,
	£11	15	10½	=difference of receipts.

FEMALES.

1. 80 dozen pairs=960 pairs.
960 pairs at 19s. 7½d.=(960 at £1 less 960 at 4½d.).

960 at 4½d. each.

4d.=$\frac{1}{60}$ of £	16=value of 960 at 4d.
½d.=⅛ of 4d.	2= ,, ,, ½d.
	£18=value of 960 at 4½d.

Therefore 960 at 19s. 7½d.=£960—18=£942.

2.

	£	s.	d.	
	3	13	6	=value of 1 cwt.
		1527		
	5611	14	6	=value of 1527 cwt.
2 qrs.=½ cwt.	1	16	9	= ,, 2 qrs.
14 lbs.=¼ of 2 qrs.		9	2¼	= ,, 14 lbs.
2 lbs.=$\frac{1}{7}$ of 14 lbs.		1	3¾	= ,, 2 lbs.
	£5614	1	9	=value of 1527 cwt., etc.

3.

	£	s.	d.
62½ tons at £3, 15s. per ton=	234	7	6
41¼ qrs. at £2, 2s. per qr.=	86	12	6
58¾ qrs. at £1, 6s. per qr.=	76	7	6
25 sacks at £1, 7s. 6d. per sack=	34	7	6
37½ tons at £4, 2s. 6d. per ton=	153	13	1½
Total,	£585	8	1½

4.

	£	s.	d.	
	3	0	6	rent for 1 month.
		61		
	184	10	6	rent for 61 months.
1 week=¼ of 1 month		15	1½	,, 1 weeks.
4 days=$\frac{4}{7}$,,		8	7½ $\frac{6}{7}$	,, 4 days.
	£185	14	3¾ $\frac{6}{7}$	rent for 61 months, etc.

Grammar.

1. *Is*—3d pers. sing. pres. indic. of the incomplete irreg. verb *am, was, been*, agr. with its subj. *it*.
sad—a common adj. qual. *it*.
to see—pres. infin. irreg. trans. verb *see, saw, seen*.
fade—pres. infin. reg. intrans. verb *to fade* (*to* omitted after verb *see*).
our—poss. adj. (pronominal) qual. *gaze*.
very—adj. qual. *gaze*.
some—indef. numeral adj. qual. *shade*.
poisonous—common adj. qual. *shade*.
droops—3d pers. sing. pres. indic. of reg. intrans. verb *to droop*, agr. with subj. *lily*.
withers—3d pers. sing. pres. indic. reg. intrans. verb *to wither*, agr. with subj. *lily*.
decays—3d pers. sing. pres. indic. reg. intrans. verb *to decay*, agr. with subj. *lily*.
is—3d pers. sing. pres. indic. of incomplete irreg. verb *am, was, been*, agr. with subj. *it*.
sad—common adj. qual. *it*.
to see—pres. infin. irreg. trans. verb *see, saw, seen*.
pure—common adj. qual. *light*.
grow—pres. infin. irreg. intrans. verb *grow, grew, grown*.
fainter—adj. with somewhat of an adverbial force, qual. *light*.

2. The following nouns form their plurals by a change in the body of the word, viz.:—

Sing.	*Plu.*	*Sing.*	*Plu.*
Man	Men.	Tooth	Teeth.
Foot	Feet.	Louse	Lice.
Goose	Geese.	Mouse	Mice.

3. Adjectives of number are sometimes used as nouns; for example:—

Adjectives.	*Nouns.*
One boy.	This is the *one*.
Fifty men.	Count by *fifties*.
Two or three girls.	How many *twos* in six.

Geography.

1. The different names given to openings in the land on the coasts of Great Britain and Ireland are:—
Frith—as Frith of Clyde, separating Ayr and Renfrew from Bute, Argyle, and Dumbarton.
Mouth—as Mouth of the Thames, between Essex and Kent.
Bay—Cardigan Bay, west of Cardigan and Merioneth.
Loch—Loch Ryan, north-west of Wigtownshire.
Lough—Lough Swilly, north of Donegal.
Harbour—Waterford Harbour, between Wexford and Waterford.
Haven—as Milford Haven, west of Pembroke.
River—in the case of Kenmare river, west of Kerry.
Names given to narrow passages of water:—
Channel—as North Channel, between Scotland and Ireland.
Strait—Straits of Dover, between Kent and France.
Sound—Sound of Mull, between Mull and Argyle.
Kyle—Kyles of Bute, between Bute and Argyle.
Peculiar are—(1) The *Narrows* of Skye. (2) The *Pentland Frith*.

2. The line of *water-parting*, separating the basins of the Thames and Severn from those of rivers flowing into the English Channel, begins in the east of Kent, and continues in a very irregular course along the Wealden Heights, the Downs of Hampshire, Salisbury Plain, Exmoor, Dartmoor, and the Cornish Highlands. The rivers flowing into the English Channel are:—the Ouse, the Arun, the Itchen, the Test, the Avon, the Frome, the Exe, and the Tamar; all which flow southward.

3. The *Orkney* and *Shetland Islands* form together one county, north of the mainland of Scotland. Chief town of the Orkneys is Kirkwall, in Pomona or Mainland; and the chief town of Shetland is Lerwick, in an island also known as Mainland. The Orkneys are mostly low and fertile; the Shetlands, mostly mere stacks of rocks, give name to a breed of ponies called Shelties.

The *Hebrides* form two groups of islands lying along the west of Scotland. The *Inner Hebrides* lie close to the coast, and consist of these principal islands: *Skye, Mull, Jura, Islay, Colonsay*, and *Oronsay*. The Outer Hebrides form a long chain, and are parted from the Inner by the Minch and Little Minch, the chief being *Lewis, Harris, N. Uist, Benbecula, S. Uist*, and *Barra*.

The *Isle of Man* lies in the middle of the Irish Sea. Chief towns are *Douglas* and *Ramsey*. The island retains its own government and judges. Its people are called Manx.

The *Island of Anglesea* forms a distinct county, separated from the mainland by the Menai Straits. Its chief town is Beaumaris. Holyhead, on Holy Island, is the point of departure of travellers from England to Ireland.

The *Isle of Wight*, south of Hampshire, famous for its beauty and the mildness of its climate, is separated from the mainland by the channels of Spithead and the Solent. Its chief towns are *Newport, Cowes, Ryde*, and *Ventnor*.

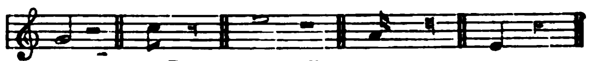
The *Channel Islands*, off the coast of Normandy in France, have belonged to England since the time of William the Conqueror. They consist of *Jersey, Guernsey, Alderney*, and *Sark* or *Sarcq*, and a few others. Chief town in Jersey, St. Helier; in Guernsey, St. Peter's Port. Alderney is noted for its breed of cattle.

Music.

1.
B E F D C

Quaver. Minim. Crotchet. Semibreve. Semiquaver.

2.



Rests corresponding to notes.

3. In the major scale are found *five tones and two semitones*,—the latter being found between the third and fourth, and seventh and eighth notes.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Reduce 18 furl. 3 poles $3\frac{3}{8}$ yds. to the decimal of 1 mile; *and* 4 ft. 6 in. to the decimal of 3 yds. 2 ft.

2. If 1191 tons 10 cwt. 1 qr. 14 lbs. cost £595, 15s. $2\frac{1}{4}$d., what is the cost of half a million tons? Work this sum by fractions.

3. A farmer has 295 more sheep than cows, and this difference is $\frac{59}{85}$ of the number of sheep he possesses; how many cows has he?

4. In exchange for 1 cwt. of coffee at 1s. 6d. per lb., how much money would you expect to receive along with 18 lbs. of tea at $\dot{4}2857\dot{1}$ of a guinea per lb.?

5. Find the greatest common measure of 805 and 1311; *and* the least common multiple of 15863 and 21489.

FEMALES.

1. How many yards of lace can I buy for £685, 17s. 9d. at the rate of five guineas for $12\frac{5}{8}$ yds.?

2. If after paying income-tax at 1s. 2d. in the pound, a gentleman has £701, 10s. 10d. remaining, what is his annual income?

3. If £69, 0s. $11\frac{1}{4}$d. pays the carriage of 47 tons 8 cwt. 33 lbs. of goods for 764 miles, what weight should be carried 573 miles for the same sum?

4. If 72 oxen require 18 acres of turnips to supply them for 30 weeks, how many acres would supply 18 score of sheep for 45 weeks, on the supposition that 9 oxen eat as much as 30 sheep?

Grammar.

1. What are the two kinds of participles? Describe them, and give examples of each.

2. Parse the pronouns in the following:—
'Which pillage they with merry march bring home
To the tent royal of their emperor.'

3. The words *each* and *other* are used both as adjectives and as pronouns; give examples of them in both uses.

4. Give notes of a simple lesson on *adverbs*, suited to Standard IV.

Geography.

Answer *either* Q. 1 *or* Q. 3, *not both*.

1. Trace minutely the line of *water-parting* which separates the basins of the Thames and Severn from those of rivers flowing into the English Channel, and describe those rivers in order.

2. Draw a full map of the coast from Cape Spartivento to Cape Matapan.

3. Describe, as fully as you can, the physical features, chief divisions, towns, and manufactures of the Austrian Empire. What title does the sovereign bear at Vienna, and what at Buda-Pesth? Why are they different?

History.

1. Give the dates of Henry I., Richard II., Richard III., and Elizabeth, and name their immediate successors.

2. Write out a list of our sovereigns from Charles I. to Anne, with dates.

3. Why is this called the nineteenth century? When did it begin, and when will it end?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Versatility*.

Write, in small hand, as a specimen of copy-setting, '*Stirred up by Dorset, Buckingham, and Morton, he comes.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Music.

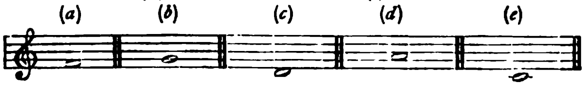
A quarter of an hour allowed for this paper.

1. Write in (*a*) the scale of D (*Re*), and in (*b*) the scale of B♭ (*Se*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

(*a*) (*b*)

2. Place its third over (*a*), its fifth over (*b*), its fourth over (*c*), its second over (*d*), and its seventh over (*e*).

(*a*) (*b*) (*c*) (*d*) (*e*)



3. How many quavers are equal (in length) to one semibreve?
,, quavers ,, ,, one minim?
,, quavers ,, ,, one crotchet?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. (*a*) $\dfrac{18 \text{ fur. } 3 \text{ po. } 3\frac{1}{2} \text{ yds.}}{1 \text{ mile}} = \dfrac{3980}{1760} \text{ yds.}$
$= \dfrac{199}{88}$
$= 2{\cdot}2613\dot{6}$. Ans.

(*b*) $\dfrac{4 \text{ ft. } 6 \text{ in.}}{3 \text{ yds. } 2 \text{ ft.}} = \dfrac{54}{132} \text{ in.}$
$= \dfrac{9}{22}$
$= {\cdot}4\dot{0}\dot{9}$ Ans.

2. 1191 tons 10 cwt. 1 qr. 14 lbs. $= 1191\frac{83}{160}$ tons $= \frac{190643}{160}$,

£595, 15s. $2\frac{1}{4}$d. $= 595\frac{243}{320} = £\frac{190643}{320}$.

Now, stating terms in fractional form,

$$\frac{190643}{160} \text{ tons} : \frac{500000}{1} \text{ tons} :: £\frac{190643}{320}$$

$$= \frac{\cancel{160} \times \cancel{500000} \times \cancel{190643}}{\cancel{190643} \times \cancel{320}\ 2} = £250000. \text{ Ans.}$$

3. 295 sheep $= \frac{59}{65}$ of whole number;

therefore $\dfrac{295 \times 65}{59} = 325$ sheep = whole number,

and thus $325 - 295 = 30$ cows. Ans.

4. Since ${\cdot}428571$ of a guinea $= \frac{3}{7}$ of 21s. = 9s.,
18 lbs. at 9s. = 162s.
and since 112 lbs. at 1s. 6d. = 168s.

therefore you would expect 6s. Ans.

5. (*a*) G. C. M. of 805 and 1311 = 23. Ans.

1	805	1311	1
	506	805	
1	299	506	1
	207	299	
4	92	207	2
	92	184	
		23 = G. C. M.	

(*b*) L. C. M. of 15863 and 21489 = 11754483,
for $15863 = 29 \times 547$,
and $21489 = 29 \times 741$;
therefore $29 \times 547 \times 741 = 11754483$ = L. C. M.

FEMALES.

1. £5, 5s. : £685, 17s. 9d. :: $12\frac{3}{4}$ yds.
$= \dfrac{164613\text{d.} \times 51 \text{ qrs.}}{1260\text{d.}} = 1665 \text{ yds. } 2\frac{127}{140}$ qrs. Ans.

2. 18s. 10d. : £701, 10s. 10d. :: £1 : £745. Ans.
$\dfrac{168370 \times £1}{226\text{d.}} = £745.$

3. 573 miles : 764 miles :: 47 tons 8 cwt. 33 lbs.
$$\frac{\overset{4}{\cancel{764}} \times \overset{35403}{\cancel{106209}} \text{ lbs.}}{\underset{3}{\cancel{573}}} = 63 \text{ tons } 4 \text{ cwt. } 44 \text{ lbs. Ans.}$$

4. 9 oxen consume quantity = 30 sheep,
1 ox consumes ,, $= 3\frac{1}{3}$,,
therefore 72 oxen consume ,, = 240 ,,

So, by substituting 240 sheep for 72 oxen, the stating of terms is as follows:—

240 sheep : 360 sheep :: 18 acres : x
30 wks. : 45 wks. :: x

$$\frac{\overset{3}{\cancel{360}} \times \overset{3}{\cancel{45}} \times \overset{9}{\cancel{18}}}{\underset{2}{\cancel{30}} \times \underset{2}{\cancel{240}}} = \frac{81}{2} = 40 \text{ ac. } 2 \text{ ro. Ans.}$$

Grammar.

1. The two kinds of *participles* are:—the *imperfect* or *incomplete*, expressing an action going on, as *passing*, *drawing*, *destroying*; and the *perfect* or *complete*, expressing an action completed, as *past*, *drawn*, *destroyed*.

2. *They*—3d pers. pron. com. gen. plu. nom. subj. of *bring*.
their—pronominal poss. adj. or 3d pers. pron. com. gen. plu. poss. attributive to *king*.

3. *Each* and *other* are adjectives when they stand before nouns and qualify them, as *each man*, *other men*; but when used without the noun they may be considered pronouns, as *two to each*; if they cannot come, invite *others*.

4. NOTES OF A LESSON FOR STANDARD IV.

THE ADVERB.

(1) Introduction.—Write sentences on blackboard, and ask from class words telling (1) *how*, (2) *where*, or (3) *when* a thing was done.
(2) Examples.—John wrote *badly*. He wrote *here*. We wrote *to-day*.
(3) Definition.—An adverb, therefore, tells the *manner*, *place*, or *time* of an action.
(4) For practice, ask pupils to find adverbs from reading book.
(5) Kinds.—Ask for lists of adverbs of *manner*, *time*, *place*, and after explaining that adverbs modify adjectives and other adverbs, ask for adverbs of *degree*.
(6) Inflections.—Show how adverbs like adjectives may be compared.

Geography.

1. The line of *water-parting*, separating the basins of the Thames and Severn from those of rivers flowing into the English Channel, begins in the east of Kent and continues in a very irregular course along the Wealden Heights, the Downs of Hampshire, Salisbury Plain, Exmoor, Dartmoor, and the Cornish Highlands. The most considerable rivers flowing into the English Channel are the Ouse, the Arun, the Itchen, the Test, the Avon, the Frome, the Exe, and the Tamar, all which flow southward.

3. Austrian Empire.—*Physical Features.*—The principal mountain ranges are the *Rhætian Alps*, the *Bohemer Wald*, connected with the *Sudetic Chain*, consisting of the *Erz-Gebirge* and the *Riesen-Gebirge*, which are connected by irregular masses with the great *Carpathian Mountains*.

The chief river is the *Danube*, which with its tributaries drains considerably more than two-thirds of the Empire. These tributaries are the *Iller*, the *Lech*, the *Iser*, the *Inn*, the *Drave*, the *Save*, the *Naab*, the *March* or *Morava*, the *Waag*, and the *Theiss*. Bohemia is watered by the upper courses of the *Elbe*, with its tributary the *Moldau*. The drainage of Galicia belongs to the *Vistula* and the *Dniester*.

Lakes Balaton and Neusiedl are the only ones of any consequence.

The chief *divisions* are—(1) The German Provinces, including *Bohemia, Moravia, Austria Proper*, and the *Tyrol*. (2) The Slavonian Provinces: *Galicia*, formerly belonging to Poland; *Hungary*, long an independent kingdom; *Transylvania* and *Croatia*. By Treaty of Berlin, *Bosnia* and *Herzegovina* were placed under Austrian protection.

The chief *towns* are *Prague*, an antique city; *Königgrätz*, near battle-field of *Sadowa* (1866); *Brünn*, seat of woollen manufactures; *Austerlitz*, battle 1805; *Vienna*, one of the finest cities in Europe, chief seat of manufactures; *Salzburg*, salt-mines—Haydn and Mozart born here; *Klagenfurt* has white-lead mines; *Idria*, famous quicksilver mines; *Trieste*, chief seaport; *Trent*, famous for Council for settling the Roman Catholic tenets; *Buda* and *Pesth* form one town, the capital of the kingdom of Hungary; *Presburg*, seat of Hungarian Diet; *Schemnitz*, chief of mining towns; *Tokay*, famous for sweet wines; *Orsova*, near the 'Iron Gates' or rapids of the Danube; *Lemberg*, noted for its fair; *Cracow*, ancient capital of Poland, has a lofty mound to the memory of Kosciusko. *Wieliczka* has the most celebrated salt-mines in the world.

The principal *manufactures* are:—*Linen* in Bohemia, Moravia, and Silesia; *woollen* in Moravia and Bohemia; *cotton* in same states; *silk* is a very important industry, and *leather fancy articles* form a conspicuous branch in Vienna; *iron* is also manufactured.

The sovereign is called *emperor* at Vienna because he is there as the ruler of an *empire*; but at Buda he is the ruler of a *kingdom*, and therefore properly a *king*. Austria is an empire, Hungary a kingdom.

History.

		A.D.			A.D.
1.	Henry I. began to reign	1100;	succeeded by	Stephen,	1135
	Richard II. ,,	1378;	,,	Henry IV.,	1399
	Richard III. ,,	1483;	,,	Henry VII.,	1485
	Elizabeth ,,	1588;	,,	James I.,	1603

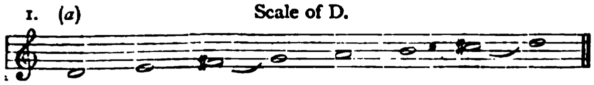
2.	Charles I.	reigned from	1625 till 1649.
	Charles II.	,,	1660 ,, 1685.
	James II.	,,	1685 ,, 1688.
	William III. and Mary II.	,,	1689 ,, 1702.
	Anne	,,	1702 ,, 1714.

3.	1st century began with A.D.	1;	ended with A.D.	100.
	2d ,, ,,	101;	,,	200.
	3d ,, ,,	201;	,,	300, etc.

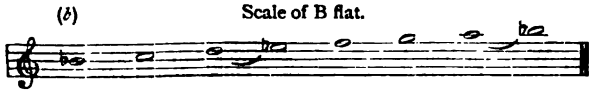
And thus 19th century began with 1801, and ends with 1900.

Music.

1. (*a*) Scale of D.



(*b*) Scale of B flat.



2. (*a*) (*b*) (*c*) (*d*) (*e*)

Third. Fifth. Fourth. Second. Seventh.

3. How many quavers are equal to one semibreve? (eight).
How many quavers are equal to one minim? (four).
How many quavers are equal to one crotchet? (two).

SECOND YEAR.

Pupil Teachers at end of Second Year, *if apprenticed on, or after,* 1 *May* 1878; **and Pupil Teachers at the end of Third Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. I sell 185 bushels of wheat for £53, 3s. 9d., thus gaining 15 per cent. At what price per bushel did I buy the wheat?

2. Having £825, I lend it at $3\frac{1}{2}$ per cent. simple interest. In how many years will it amount to £1000, and what amount shall I have to receive at the end of 30 years, nothing having been paid in the meantime?

3. £91·6 amounts in 3·5 years to £105·302083, what is the rate per cent. per annum simple interest?

4. How must nutmegs which cost 18·75s. a lb. be sold so as to gain 16 per cent.?

5. A plumber sold 96 cwt. of lead for £109, 2s. 6d. and gained at the rate of $12\frac{1}{2}$ per cent. What did the lead cost him per cwt.?

FEMALES.

1. Find the least common denominator of—

$$\frac{5}{27},\ \frac{11}{24},\ \frac{5}{6},\ \frac{4}{15},\ \text{and}\ \frac{3}{5}.$$

2. What number added to $\frac{7}{8}+\frac{5}{12}$ will give $2\frac{1}{8}$?

3. Simplify

$$\left(2\frac{3}{4}+\frac{5}{2}\text{ of }\frac{7}{3\frac{4}{5}}-\frac{1\frac{2}{3}}{2\frac{1}{3}}\right)1\frac{77}{228}.$$

4. If a person, travelling $13\frac{3}{4}$ hours a day, perform a journey in $27\frac{3}{8}$ days, in what time will he perform the same if he travel $10\frac{3}{4}$ hours a day?

Grammar.

1. And oh when passion rules—how rare
The hours that fall to virtue's share!

Analyse the above, supplying what is needed in the principal sentence, and taking care in your analysis to point out the character of each sentence.

2. Give examples of conjunctions of time, and frame passages with such conjunctions introduced, to show their use.

3. Parse each word in the following:—
'The evil that men do lives after them.'

4. Give notes of a lesson on transitive and intransitive verbs suited to Standard IV. or V.

Geography.

Answer *two* questions only.

1. Describe, as fully as you can, the physical features, chief divisions, towns, and manufactures of the Austrian Empire. What title does the sovereign bear at Vienna, and what at Buda-Pesth? Why are they different?

2. Draw a full map of the Basin of the Ganges; marking its tributaries and chief towns, and noting the point at which the course of the Jumna is nearest that of the Sutlej.

3. Give notes of a lesson on this sentence:—
'All Europeans, who live in Calcutta or Madras, escape to the hills, if they can, for the hot season.'

Arrange your notes under these heads:—

(*a*) Who are meant by 'Europeans'? And why are they in India?

(*b*) Where are Calcutta and Madras? Why are they unhealthy in the hot season?

(*c*) What is 'the hot season'? And what are the causes of it?

(*d*) What hills can they go to? Mention any places in the hills.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. What was the extent in time and territory of the Roman occupation of Britain? Compare the condition of the Romans and the Britons nineteen centuries ago.

2. Mention circumstances in the internal condition of England which facilitated the Norman Conquest.

3. Describe the end of Richard II., and tell how the Crown was settled after that event.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Versatility*.

Write, in small hand, as a specimen of copy-setting, *Stirred up by Dorset, Buckingham, and Morton, he comes.*

Composition.

Write full notes of a lesson on *A desert.*

Euclid.

[All generally-understood abbreviations for *words* may be used, but not symbols of *operations*, such as —, +, ×.]

[In solving a rider, only the proposition to which it is appended, and preceding propositions, may be referred to.]

1. If two triangles have two sides of the one equal to two sides of the other, each to each, and have likewise the angles contained by those sides equal to each other; they shall likewise have their bases or third sides equal, and the two triangles shall be equal, and their other angles shall be equal, each to each, viz. those to which the equal sides are opposite.

ABDE, BFGC are squares on two sides of the triangle ABC, and AF, CD are joined; show that AF, CD are equal.

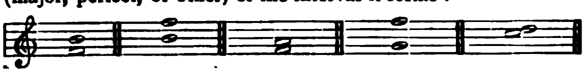
2. The greater side of every triangle is opposite to the greater angle.

Point out where the *demonstration* begins.

Music.

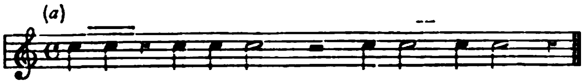
A quarter of an hour allowed for this paper.

1. Write under each of the following the name and quality (major, perfect, or other) of the interval it forms :—



2. Divide (by bars) the notes in (*a*) into measures of common time; those in (*b*) into measures of triple :—

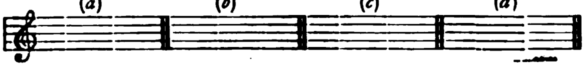
(*a*)



(*b*)

3. Write in (*a*) the signature of A (*La*), in (*b*) that of B♭ (*Se*), in (*c*) that of D (*Re*), and in (*d*) that of F (*Fa*).

(*a*) (*b*) (*c*) (*d*)



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. 1 bushel is sold at 5s. 9d.;

$\therefore$ 115 : 100 :: 5s. 9d. : 5s. Ans.

2. Interest on £825 for time = £175;

$\therefore$ £825 : £100 :: 1 year
$3\frac{1}{2}$: 175

$$\frac{100 \times 175 \times 1}{825 \times 3\frac{1}{2}} = 6\frac{2}{33} \text{ years.}$$

2. (*b*) Interest of £825 for 30 years at $3\frac{1}{2}$ per cent.

$$= \frac{825 \times 30 \times 3\frac{1}{2}}{100} = £866,\ 5s.;$$

$\therefore$ £866, 5s. + £825 = £1691, 5s., the amount. Ans.

3. Prin., £91·6 = $91\frac{3}{5}$ = £ 91 13 4
Amt., £105·302083 = 105 6 $0\frac{1}{2}$

$\therefore$ interest = 13 12 $8\frac{1}{2}$

£$91\frac{3}{5}$: £100 :: £13, 12s. $8\frac{1}{2}$d.
$3\frac{1}{2}$ yrs. : 1 yr.

$$\frac{100 \times £13,\ 12s.\ 8\frac{1}{2}d.}{91\frac{3}{5} \times 3\frac{1}{2}} = £4\frac{1}{4} \text{ rate p. c. Ans.}$$

4. 100s. : 116s. :: 18·75s. : 21s. 9d.

$$\frac{116 \times 18{\cdot}75}{100} = £1,\ 1s.\ 9d. \text{ Ans.}$$

5. $112\frac{1}{2}$: 100 :: £$109\frac{1}{8}$: prime cost of 96 cwt.

$$\frac{100 \times 109\frac{1}{8}}{112\frac{1}{2}} = £97;$$

$\therefore$ the price of 1 cwt. = £97 ÷ 96 = £1, 0s. $0\frac{1}{4}$d.

FEMALES.

1. The least common denominator = L. C. M. of denominators of fractions.

L. C. M. of 27, 24, 6, 15, 5 = 27 × 8 × 5 = 1080 L. C. D.

2. The problem may be written thus :—

$$\frac{17}{8} - \left(\frac{7}{8} + \frac{5}{12}\right), \text{ or } \frac{51}{24} - \frac{21+10}{24} = \frac{51-31}{24} = \frac{5}{6}. \text{ Ans.}$$

3. This problem
$$= \left(\frac{11}{4} + \frac{5 \times 35}{2 \times 19} - \frac{5 \times 2}{3 \times 5}\right)\frac{305}{228}$$
$$= \left(\frac{11}{4} + \frac{175}{38} - \frac{2}{3}\right)\frac{305}{228}$$
$$= \left(\frac{627 + 1050 - 152}{228}\right)\frac{305}{228}$$
$$= \frac{1525 \times 305}{228 \times 228}$$
$$= \frac{465125}{51984} = 8\frac{49353}{51984}.$$

4. $10\frac{2}{3}$ hours : $13\frac{3}{4}$ hours :: $27\frac{5}{8}$ days :

$$\frac{13\frac{3}{4} \times 27\frac{5}{8}}{10\frac{2}{3}} = \frac{7 \times 55 \times 221}{72 \times 4 \times 8} = \frac{85085}{2304} = 36\frac{2141}{2304} \text{ days. Ans.}$$

Grammar.

Sentence.	Subject.	Predicate.	Completion.	Extension.
(1) And oh when passion rules. (*Adverbial sentence, subordinate to* (2).)	(And oh when) passion	rules	...	...
(2) How rare (*are*) the hours. (*Principal sentence.*)	the hours	are rare	...	How
(3) That fall to virtue's share. (*Adjective sent. subordinate to* '*hours.*')	That	fall	to virtue's share	...

2. The conjunctions of *time* are :—*when, while, as, until, ere, before, after.*

SENTENCES.

I will come *when* I am at leisure.
I will praise thee *while* I live.
As I looked some one came near.
They remained *until* night set in.
It will be long *ere* you have such a chance.
The truth will come out *before* you have done.
After the vote was taken, the assembly broke up.

3. *The*—def. art. or dist. adj. qual. *evil.*
evil—abs. noun, neut. sing. nom. subj. of *lives.*
that—simple rel. 3d pers. sing. neut. (agr. with *evil*), obj. gov. by *do.*
men—com. noun, masc. plur. nom. subj. of *do.*
do—3d pers. plur. pres. ind. irreg. trans. verb, *do, did, done,* agr. with *men.*
lives—3d pers. sing. pres. ind. reg. intrans. verb *to live,* agr. with *evil.*
after—prep. gov. *them.*
them—3d pers. pron. plur. masc. (agr. with *men*), obj. by *after.*

4. NOTES OF LESSON.

ON TRANSITIVE AND INTRANSITIVE VERBS.

(1) Write on blackboard such sentences as: 'Tom *strikes* the dog.' 'He *ate* the apple.' Show that *strikes* without some object would give an incomplete idea; that *ate* is another verb requiring an object.
(2) Write also such sentences as: 'Tom *runs.*' 'He *sings.*' 'She *sleeps.*' Show that *runs, sings, sleeps,* complete the meaning in themselves, and do not require an object.
(3) Explain now that *transitive* means a passing over of the action from the subject to the object, and that *intransitive* means a confining of the action of the verb to its subject.
(4) Now may be introduced the *Passive voice,* which belongs only to transitive verbs.

Geography.

1. *See same question fully answered, under Geography of First Year.*

3. NOTES OF LESSON.

(*a*) By 'Europeans' are meant those British or others from Europe who are resident in India, and serve the Government, whether as soldiers or civil servants, also civilians as merchants.

(*b*) *Calcutta,* situated on the Hooghly, a branch of the Ganges, is the capital of British India. *Madras,* on the Coromandel

coast, on the Bay of Bengal, capital of the Madras Presidency. Both cities are unhealthy during the hot season from the malaria, or noxious vapours which cause fever.

(*c*) 'The hot season' is the period when the tropical sun strikes the earth with almost vertical rays. The land becomes parched and brown, the small rivers dry up, and the heat is almost unbearable. It lasts from March to June.

(*d*) The heat is much subdued on the hills, to which Europeans go to regain their health. The places most frequented by invalids are: *Darjeeling*, south of Sikkim, *Simla* in the Punjaub, *Mount Aboo* in the Aravulli range, *Mahabuleshwar*, and the *Neilgherries*.

History.

1. The Romans invaded Britain under Julius Cæsar 55 and 54 B.C., but it was not until A.D. 43 that a footing was obtained in the island, which they held till the withdrawal of the Roman legions in A.D. 410. They conquered all the country now corresponding to the present England, Wales (partly), and Scotland as far as to the line between the Friths of Forth and Clyde.

Nineteen centuries ago, the Romans were the conquerors of the then known world. They were so skilled and powerful in war, that no nation dared withstand them. They were wise, brave, and laborious. Compared with the Romans, the Britons were mere barbarians, and to their conquerors they were indebted for the making of roads, the construction of houses, principles of good government, for a proper coinage, and the development of the wealth of the country.

2. The Norman Conquest was partially facilitated by Edward the Confessor introducing the French language and customs among the Saxon nobility, thus forming a faction favourable to William's government. After the battle of Hastings, the Norman and Saxon aristocracy intermarried, and thus consolidated the new power.

3. Richard II., after being deposed by Henry Bolingbroke, Duke of Lancaster, was imprisoned in Pontefract Castle, where it is supposed he met a violent death. Henry succeeded to the throne as Henry IV., and was the first sovereign of the House of Lancaster (1399).

NOTES OF A LESSON.

A DESERT.

Definition.—A desert is a barren tract of country, generally covered with sand or rocks.

Description.—Covered with hot shining sand, which hurts the eyes and burns the feet. No water. Hot winds sometimes arise called 'sirocco' and 'simoom.' Travellers throw themselves down till the storms pass. Here and there a fertile spot occurs, where travellers refresh themselves. Such spots called 'oases,' having water, green grass, and palm trees.

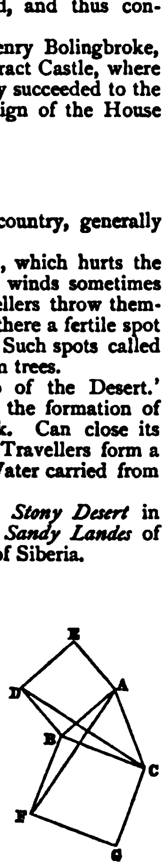
How crossed.—The camel called the 'Ship of the Desert.' Peculiarly adapted for long journeys, from the formation of stomach and the hump of fat on its back. Can close its eyes and nostrils against the 'hot wind.' Travellers form a caravan for protection against robbers. Water carried from oasis to oasis in skins.

Examples of Deserts.—*Sahara* in Africa, the *Stony Desert* in Arabia, the *Prairies* of North America, *Sandy Landes* of France, the *Maremme* of Italy, the *Steppes* of Siberia.

Euclid.

1. Prop. 4, Book I.

Rider.—Let ABC be a triangle. On AB, BC describe the squares ABDE, BFGC, and join AF, CD. Then AF shall be equal to CD.



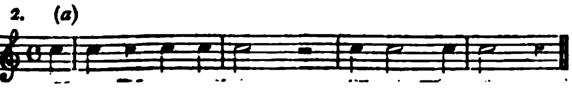
Since AB = BD and CB = BF, being sides of squares, and since all right angles are equal to one another, then the angle DBA = angle FBC. To each add angle ABC; then the whole angle DBC = whole angle ABF, and the sides containing these angles are equal, each to each, viz. DB, BA respectively equal to AB, BF, and therefore by Prop. 4 the base AF = base CD. Q.E.D.

Music.

1.

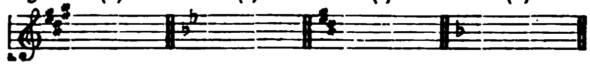
Perfect 4th. Imperfect 5th. Major 3d. Minor 7th. Major 2d.

2. (*a*)



(*b*)

3. (*a*) (*b*) (*c*) (*d*)



THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May* 1878; **and Pupil Teachers at end of Fourth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. A gives B £63, 17s. 6d. as payment of a loan and interest, at the rate of $3\frac{3}{4}$ per cent. The money was lent $3\frac{3}{4}$ years before. What was the amount of the loan?

2. A person has $\frac{1}{4}$ of a ship worth £6600, and insured for 91·25 per cent. of its real value; what amount of damage would he sustain in case of the ship being lost?

3. £825 for ·825 of a year at 8·25 per cent.: find simple interest and amount.

4. At what price per yard must cloth be sold to gain 17 per cent., if by selling 109 yards of it for £46, 6s. 6d., 8 per cent. be gained?

5. Divide £10,000 among A, B, C, so that A may have half as much again as B, and B a third as much again as C.

FEMALES.

1. Find the sum, difference, product, and quotient—the greater being divided by the less—of 1·015 and ·01015.

2. Find the difference between $6\frac{1}{2}$ half guineas and £3·525; and reduce the result to the decimal of a crown.

3. Add $5\frac{1}{2}$ cwt. to 3·125 qrs.; and reduce the sum to the decimal of a ton.

Grammar.

1. Words or phrases attached to the nouns of a sentence are called *enlargements*, attached to the verbs they are called *extensions*. Give two examples of each.

2. 'Dost thou so *hunger* for my empty chair
That thou wilt *needs invest* thee with mine honours?
Stay but a little; for my cloud of dignity
Is held from *falling* with so weak a wind
That it will quickly drop.'

SHAKESPEARE, *Henry IV.*

(*a*) Analyse the last three lines.

(*b*) Parse the words in italics.

(*c*) Give the meaning of the above passage in your own words, explaining, so far as you can, the figures and metaphors.

3. What are the Latin prepositions that mean *out of, from, under?* Give examples of words in which they occur, pointing out the force of the preposition in each case.

Geography.

Answer two Questions only; but Nos. 1 and 2 *if you can.*

1. Give notes of a lesson on this sentence:—

'*All Europeans, who live in Calcutta or Madras, escape to the hills, if they can, for the hot season.*'

Arrange your notes under these heads:—

(*a*) Who are meant by 'Europeans,' and why are they in India?

(*b*) Where are Calcutta and Madras? Describe *exactly* the situation of each.

(*c*) What is the hot season, and what are the causes of it?

(*d*) What hills can they go to? Name any places in the hills.

2. Draw a map, showing the courses of the Senegal and the Quorra or Niger, and the coast-line between their mouths.

3. Describe the East Coast of Africa, and the islands opposite to it.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

Euclid.

[All generally-understood abbreviations for *words* may be used, but not symbols of *operations*, such as —, +, ×.]

1. If a side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles; and the three

interior angles of every triangle are together equal to two right angles.

The difference of the angles at the base of any triangle is double the angle contained by two lines drawn from the vertex, one bisecting the vertical angle, the other perpendicular to the base.

2. Equal triangles upon the same base and upon the same side of it, are between the same parallels.

Point out where the *demonstration* begins.

History.

1. Explain the relations of Mary Stuart to the thrones of Scotland, England, and France.

2. How did Charles I. regard Parliament? What were the consequences?

3. Show the descent of Queen Victoria from James I.; and compare the extent of dominion of the two monarchs.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Versatility.*

Write, in small hand, as a specimen of copy-setting, '*Stirred up by Dorset, Buckingham, and Morton, he comes.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Algebra.

1. Simplify $a-(b-c)-\{b-(a-c)\}-[a-\{2b-(a-c)\}]$; and show that

$$\frac{a+c}{(a-b)(x-a)}-\frac{b+c}{(a-b)(x-b)}=\frac{x+c}{(x-a)(x-b)}.$$

2. Find the G. C. M. of $a^3(b^4-b^2c^2)$ and $b^3(ab+ac)^2$.

3. Solve the equations:—

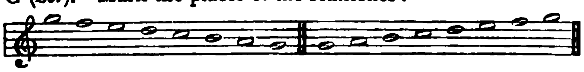
$$(1)\ \frac{7\cdot1-3x}{\cdot5}-\cdot8x=9\cdot44.$$

$$(2)\ \frac{12}{x}+\frac{1}{12x}=\frac{29}{24}.$$

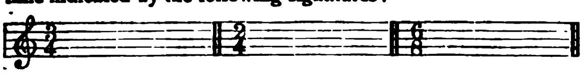
Music.

A quarter of an hour allowed for this paper.

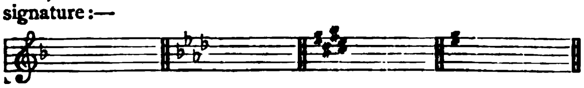
1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of G (*Sol*). Mark the places of the semitones:—



2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures:—



3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature:—



ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. Interest of £100 for $3\frac{3}{4}$ years at $3\frac{3}{4}$ per cent.

$$=\frac{100\times3\frac{3}{4}\times3\frac{3}{4}}{100}=£14\tfrac{1}{16};$$

$$\therefore\ 114\tfrac{1}{16}:100::£63\tfrac{7}{8}:£56,$$

$$\text{that is, }\frac{1825}{16}:\frac{100}{1}::£\frac{511}{8}.$$

$$\frac{16\times100\times511}{1825\times8}=£56.\ \text{Ans.}$$

2. Since 8·75 per cent. is lost, therefore

100 : 8·75 :: £6600 : £577, 10s.

$\frac{1}{7}$ of £577, 10s. = £82, 10s. Ans.

3. Interest $=\dfrac{£825\times\cdot825\times8\cdot25}{100}=£56\cdot15625$

	£	s.	d.
= interest =	£56	3	$0\frac{1}{4}\frac{1}{2}$
	825	0	0
∴ amount =	£881	3	$0\frac{1}{4}\frac{1}{2}$. Ans.

4. 109 yds. cost £46, 6s. 6d.

1 yd. „ 8s. 6d.

108 : 117 :: 8s. 6d. : 9s. $2\frac{1}{2}$d. Ans.

5. To avoid fractions, suppose C has 3 shares;

then B „ 4 „

and A „ 6 „

Total, 13 shares.

So C gets $\frac{3}{13}$ of £10,000 or £2307, 13s. $10\frac{2}{13}$d. Ans.

B „ $\frac{4}{13}$ „ „ „ £3076, 18s. $5\frac{7}{13}$d. „

A „ $\frac{6}{13}$ „ „ „ £4615, 7s. $8\frac{4}{13}$d. „

FEMALES.

1. (1) Sum.

1·015
·01015
1·02515. Ans.

(2) Difference

1·015
·01015
1·00485. Ans.

(3) Product.

1·015
·01015
5075
1015
1015
·0103025. Ans.

(4) Quotient.

·01015) 1·015 (100. Ans.
1·015

2.

	£	s.	d.
$6\frac{1}{2}$ half-guineas =	3	8	3
£3·525 =	3	10	6
Difference =		2	3

Reducing 2s. 3d. to the decimal of 5s.

$=\frac{27}{60}$d. = ·45. Ans.

3. $5\frac{1}{2}$ cwts. = 22 qrs.,

and 3·125 qrs. + 22 qrs. = 25·125 qrs.,

which reduced to the decimal of a ton

$=\dfrac{25\cdot125}{80}$ qrs. = ·3140625. Ans.

Grammar.

EXAMPLES OF ENLARGEMENTS.

1. (1) *The queenly* form is shattered.
(2) The sound *of the hunters' horns* is heard.

EXAMPLES OF EXTENSIONS.

(1) *Sweetly* smiled the morn.
(2) The baron died *in his chamber dull.*

2. (*a*)

Sentence.	Connective.	Subject.	Predicate.	Completion.	Extensions.
(1) Stay but a little. (*Principal.*)	...	(thou)	stay	...	but a little (*time*).
(2) For my cloud of dignity is held from falling with so weak a wind. (*Adverbial of cause subord. to* (1).)	for	my cloud of dignity	is held	from falling	with so weak a wind (*manner*).
That it will quickly drop. (*Adverbial of consequence to* (2).)	that	it	will drop	...	quickly (*time*).

(*b*) *Hunger*—pres. inf. reg. intrans. verb *to hunger.*
dost hunger—interrog. form, 2d pers. sing. pres. indic. agr. with *thou.*

needs—adv. mod. *invest*.
invest—pres. inf. reg. trans. verb *to invest*.
will invest—2d pers. sing. fut. indic. agr. with *thou*.
stay—reg. intrans. verb, imper. mood, 2d pers. agr. with subj. *thou*.
falling—irreg. intrans. verb (*fall*, *fell*, *fallen*), pres. part., gov. by *from*.
that—conj. connect. subord. clause with principal.

(*c*) Are you so anxious to get possession of my position that you are already considering yourself entitled to the honours which belong to me? Have patience a short time longer, for I shall soon be obliged to lay aside my authority for want of supporters.

Notes.—'Hunger for my chair'—a metaphorical expression taken from the anxiety of a hungry person to get food.

'Chair'—metonymy for 'office;' a similar expression to 'desiring the throne'—that is, 'wishing to be king.'

'Invest thee with mine honour'—a metaphor taken from the ceremony of clothing a person in robes of office.

'For my cloud of dignity,' etc.—a metaphor taken from the fact that the clouds are supported by the atmosphere, which carries them until they become too dense, when they descend as rain.

'Stay but a little'—an implied metaphor, equal to 'Control yourself.'

3. *e* or *ex* means *out of*, as { *e*-ject, to cast out of. / *ex*-tract, to draw out of.
a, *ab*, *abs* „ *from*, as { *a*-vert, to turn from. / *ab*-duct, to lead from. / *abs*-tract, to draw from.
sub „ *under*, as { *sub*-way, a road under. / *sub*-tract, to draw from under.

Geography.

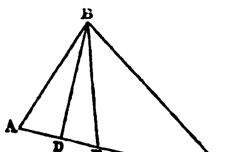
1. *See same question answered in Geography of 'Second Year.'*

3. The east coast of Africa extends in a north-easterly direction from *Delagoa Bay* to the *Gulf of Aden*. The principal projections occur at *C. Corrientes*, the town of *Mozambique*, *C. Delgado*, and *C. Guardafui*. The openings in the coast are Sofala Bay and the *Bight of Zanzibar*. The coast is alluvial, with mountains in the interior. The only river of any importance is the *Zambesi*. The political divisions are *Sofala*, *Mozambique*, *Zanzibar*, *Ajan*, and *Somali*. The towns on the coast are *Inhambane*, *Sofala*, *Quilamane*, *Mozambique*, *Zanzibar* on an island, and *Magadoxa*. Off the coast is the large island of *Madagascar*, with its capital, Tananarivo. It is a beautiful island, with lofty mountains in the interior, and is separated from the mainland by the *Channel of Mozambique*. The other islands are *Bourbon*, ch. town *St. Denis*; *Mauritius*, ch. town *Port Louis* (belongs to Britain); *Comoro Isles*, north of Madagascar; *Socotra*, isle near C. Guardafui; the *Seychelles* and *Amirante Islands* belong to Britain, and lie out in the Indian Ocean, opposite Zanzibar.

Euclid.

1. Prop. 31, Book I.

Rider.—Let ABC be a triangle. From B let fall the perpendicular BD, and bisect the angle ABC by the straight line BE. Then the difference of the angles BAC, ACB shall be equal to twice the angle DBE. Now, since the angles DAB, ABD are together equal to a right angle, and that DCB, GBD are also equal to a right angle; ∴ DAB, ABD are equal to the angles DCB, DBC taken together. Add DBE to these equals, and then the angles DAB, ABD, DBE = angles DCB, DBC, DBE taken together, or DAB, ABD, DBE together = angles DCB, CBE, and twice angle DBE. But ABD, DBE together = half angle ABC = CBE; ∴ the remaining angle DAB = angle DCB and twice DBE—that is, the angle DAB is greater than DCB by twice the angle DBE. Q.E.D.



2. Prop. 39, Book I.

History.

1. Mary Stuart, daughter of James V. of Scotland, succeeded him as Queen of Scots. She was the grand-niece of Henry VIII., and, setting Elizabeth aside, she had the best claim to the throne of England. As the wife of Francis II. she was Queen of France.

2. Charles I. regarded Parliament merely as an assembly at his service for raising money. His own words respecting Parliament were: 'Parliaments are altogether in my power for their calling, sitting, and dissolution; and therefore as I find the fruit of them to be good or evil, they are to continue or not to be.' His obstinacy led to civil war, and to his own execution (1649).

3. The descent of Queen Victoria from James I. is best seen from the following genealogical table:—

James I.
Daughter Elizabeth *m.* Elector Palatine.
Daughter Sophia *m.* Ernest Augustus, Elector of Hanover.
Son George I. *m.* Sophia of Zell.
Son George II. *m.* Caroline of Anspach.
Son Frederick, Prince of Wales.
Son George III. *m.* Charlotte of Mecklenburg Strelitz.
George IV. | William IV. | Edward, Duke of Kent, | Ernest Augustus, King of Hanover.
Victoria, *b.* 1819, *m.* Prince Albert of Saxe-Coburg and Gotha.

At the time of James I. the British Empire, besides the British Isles, included only small portions of the continent of North America; but now the British Empire, besides the British Isles, includes possessions in Europe with an area of 120,000 sq. miles; in India, an area nineteen times that of Great Britain; in Ceylon, an area half that of England; in Australia and New Zealand, an area equal to Europe; in North America, an area 30 times that of Great Britain; in the West Indies, Honduras, and Guiana, an area exceeding that of Great Britain; in South Africa, an area four times that of Great Britain; and in West Africa, an area equal to half that of England.

Algebra.

1. (*a*)
$$a-(b-c)-\{b-a(a-c)\}-[a-\{2b-(a-c)\}]$$
$$=a-b+c-\{b-a+c\}-[a-\{2b-a+c\}]$$
$$=a-b+c-b+a-c-[a-2b+a-c]$$
$$=a-b+c-b+a-c-a+2b-a+c=c. \text{ Ans.}$$

(*b*) Reducing to a common denominator, we get
$$\frac{(a+c)(x-b)-(b+c)(x-a)}{(a-b)(x-a)(x-b)}$$
$$=\frac{(ax+cx-ab-bc)-(bx+cx-ab-ac)}{(a-b)(x-a)(x-b)}$$
$$=\frac{ax+cx-ab-bc-bx-cx+ab+ac}{(a-b)(x-a)(x-b)}$$
$$=\frac{ax-bx+ac-bc}{(a-b)(x-a)(x-b)}=\frac{(a-b)x+(a-b)c}{(a-b)(x-a)(x-b)}$$
$$=\frac{(a-b)(x+c)}{(a-b)(x-a)(x-b)},$$
and after cancelling by $(a-b)=\frac{x+c}{(x-a)(x-b)}$.

2. (1) $a^3(b^4-b^2c^2)=a^3b^2(b^2-c^2)=a(a^2b^2)(b+c)(b-c)$.
(2) $b^3(ab+ac)^2=a^2b^3(b+c)^2=b(a^2b^2)(b+c)(b+c)$;
and therefore the G. C. M. $=a^2b^2(b+c)$, or $a^2b^3+a^2b^2c$.

3. (1) Multiplying by ·5, we get

$$7·1-3x-·4x=4·72.$$

By transposing, $7·1-4·72=3·4x$,

$$2·38=3·4x,$$
$$x=·7.$$

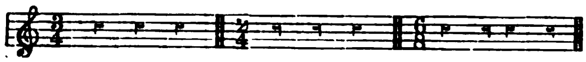
(2) Reducing to common denominators, we get

$$288+2=29x,$$
$$x=10.$$

Music.

1.

2.



3.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May* 1878; **and Pupil Teachers at end of Fifth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. 3 persons rent a piece of land for £60, 10s. The first puts in 5 sheep for $4\frac{1}{2}$ months, the second 8 sheep for 5 months, the third 9 sheep for $6\frac{1}{2}$ months; what share should each pay of the rent?

2. Compare the incomes to be derived from investing £3500 in the $3\frac{1}{2}$ per cents. at 98, and £3995 in the same stock at $99\frac{7}{8}$.

3. If teas at 2s. 9d., 3s. 3d., 2s. 4d. respectively be mixed in equal quantities, and the mixture be sold at 16 guineas per cwt., what will be the gain or loss per cent.?

4. What percentage on $\sqrt[3]{1,000,000,000}$ is $\sqrt{112}\times\sqrt{175}$?

5. Find two decimal fractions together equal to $\frac{1}{16}$, and such that one shall be $\frac{1}{18}$ of the other.

FEMALES.

1. What sum of money will amount to £256, 10s. in 4 years at $3\frac{1}{2}$ per cent. simple interest?

2. If a man can travel 198 miles by railway for £2, 9s. 6d., how far at the same rate of charge ought he to be carried for £8, 0s. $10\frac{1}{2}$d.?

3. The price of a work which comes out in parts is £2, 16s. 8d., but if the price of each part were 13d. more than it is, the price of the work would be £3, 7s. 6d. How many parts are there?

4. Divide £11,000 among 4 persons, A, B, C, D, in the proportions of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$.

Grammar.

1. 'And to a pleasant grove I 'gan to pass
Long *ere* the brightë sun *uprisen* was;
In which were oakës great, straight *as* a line,
Under the which the grass, so fresh of hue,
Was newly *sprung; and an eight foot or nine*
Every tree well from his fellow grew,
With branchës broad, laden with leavës new,
That sprangen out against the sunnë sheen;
Some very red; and some a glad light green;
Which, as *me thought*, was a right pleasant sight.'
CHAUCER, *The Flower and the Leaf.*

(*a*) Notice any points in which the English of the above passage differs from modern English.

(*b*) How many sentences are there in it, and by what means are they connected?

(*c*) Name the particular kind of sentence to which each belongs.

(*d*) Parse the words in italics.

2. Give the origin (old English derivation) of the following words:—*ought, must, durst;* and of *better, worst, least, cunning.*

Geography.

1. Give notes of a lesson on 'Central America,' and illustrate it by a map.

2. Describe fully the Indian Ocean, with the seas, gulfs, and bays connected with it, its chief currents and periodical winds.

SECOND PAPER.

One hour allowed for Females, two hours and a half for Males.

History.

1. What families have occupied the throne of England since 1066, and from what countries did they severally spring?

2. Mention the chief foreign possessions of the British Crown, and tell when they were severally acquired.

3. Give some account of the chief manufactures of England. Tell in what parts of the kingdom they are now carried on, and point out any changes which have taken place in this respect.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Versatility.*

Write, in small hand, as a specimen of copy-setting, '*Stirred up by Dorset, Buckingham, and Morton, he comes.*'

Composition.

Write an essay on *The difference between Trades and Professions.*

Euclid.

(The only abbreviation allowed for '*the square on AB*' is '*sq. on AB*,' and for '*the rectangle contained by AB and CD*,' '*rect. AB, CD.*')

1. Upon the same base, and on the same side of it, there cannot be two triangles that have their sides which are terminated in one extremity of the base, equal to one another, and likewise those which are terminated in the other extremity.

2. If a straight line be divided into two equal parts, and also into two unequal parts; the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

3. If from the right angle of a right-angled triangle lines be drawn to the opposite angles of the square described on the hypotenuse, the difference of the squares on these lines is equal to the difference of the squares on the two sides of the triangle. [Use II. 12.]

Algebra.

1. Reduce to the lowest terms $\dfrac{9x^3+6x^2-2x-4}{12x^3-5x^2+4x-4}$.

2. An express train leaves London for Manchester (188 miles) at 9 A.M., travelling 40 miles an hour; a slow train leaves Manchester for London at 11 A.M., travelling 20 miles an hour; when will they meet?

3. Solve the equations:—

$$(1)\quad \begin{cases} 7x-16y=42. \\ 5x+17y=30. \end{cases}$$

$$(2)\quad -\frac{1}{1-x^2}-\frac{7}{8}=\frac{1}{1-x}-\frac{1}{1+x}.$$

Mensuration.

1. Find the length of a circular arc whose radius is 20 ft. 9 in., and which contains an angle of 15° 9′.

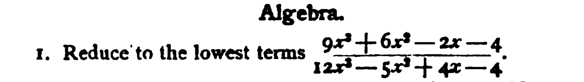
2. The sides of a triangle are 13 ft., 15 ft., 18 ft.; find the two parts into which the greatest side is divided by the perpendicular from the opposite angle.

Music.

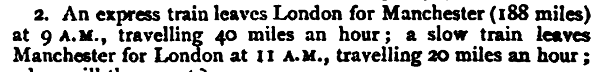
A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of E (*Mi*) minor in every form with which you are acquainted. Mark the places of the semitones, and augmented intervals.

2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms:—



3. Write the following, at the same pitch, on the bass stave:—



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. 5 sheep for $4\frac{1}{2}$ months $=$ 1 sheep for $22\frac{1}{2}$ months.
   8 " 5 " $=$ 1 " 40 "
   9 " $6\frac{1}{2}$ " $=$ 1 " $58\frac{1}{2}$ "

   Total, 121 months.

The proportions are therefore
121 months : $22\frac{1}{2}$ :: £60, 10s. : £11, 5s. Ans.
121 " : 40 :: £60, 10s. : £20, 0s. Ans.
121 " : $58\frac{1}{2}$ :: £60, 10s. : £29, 5s. Ans.

2. £98 : £3500 :: £$3\frac{1}{2}$: £125 = first income.
   £$99\frac{1}{2}$: £3995 :: £$3\frac{1}{2}$: £140 = second income.

3.

	s.	d.
1st tea costs	2	9
2d "	3	3
3d "	2	4
therefore the 3 lbs. cost	8	4 when mixed,
1 lb. costs	2	$9\frac{1}{3}$ on an average.

112 lbs. sell at £16, 16s., or 1 lb. sells at 3s.
There is therefore a gain of $2\frac{2}{3}$d. per lb.
2s. $9\frac{1}{3}$d. : $2\frac{2}{3}$ :: £100 : 8 p. c. gain.

4. $\sqrt{112 \times 175} = \sqrt{19600} = 140,$

$\sqrt[3]{1,000,000,000} = 1000.$

The question is, If 1000 gain 140, what will 100 gain?
1000 : 140 : 100 :: 14. Ans.

5. There are 15 parts in the one number,
and 1 part in the other,

or 16 parts in both.
Therefore 16 : 15 :: $\frac{1}{15}$: $\frac{1}{16}$ = ·0625. Ans.
16 : 1 :: $\frac{1}{15}$: $\frac{1}{240}$ = ·00416. Ans.

FEMALES.

1. £100 amounts to £114 in given time and at given rate; therefore £114 : £100 :: £256, 10s. : £225. Ans.

2. £2, 9s. 6d. : £8, 0s. $10\frac{1}{2}$d. :: 198 miles.
$$\frac{3861 \times 198}{1188} = 643\tfrac{1}{2} \text{ miles. Ans.}$$

3. Price of work = £2 16 8
13d. more on each part would make the price = £3 7 6

Difference on whole = £0 10 10

∴ number of parts × 13 = 130d.,
130 ÷ 13 = 10. Ans.

4. A's proportion = $\frac{1}{2}$, or 30 sixtieths,
B's " = $\frac{1}{3}$ " 20 "
C's " = $\frac{1}{4}$ " 15 "
D's " = $\frac{1}{5}$ " 12 "

77 "

	£	£	s.	d.	
77 : 30 ::	11,000 :	4285	14	$3\frac{3}{7}$.	A's.
77 : 20 ::	11,000 :	2857	2	$10\frac{2}{7}$.	B's.
77 : 15 ::	11,000 :	2142	17	$1\frac{5}{7}$.	C's.
77 : 12 ::	11,000 :	1714	5	$8\frac{4}{7}$.	D's.

Grammar.

1. (*a*) In the given lines the following may be noted as different from modern English:—

'*gan*; *-ë* in *brightë*; *up* joined to *risen*; *ës* in *oakës*; *the* joined to *which*; *an eight foot or nine*; accent on second syllable of *every*; *well from his fellow*; *his* = *its*; *-ës* in *branchës* and *leavës*; *-en* accented in *laden*; *-en* in *sprangen*; *-ë* in *sunnë*; accent on *a*.

(*b*) and (*c*) may be answered together, thus:—

(1) 'And to a pleasant a grove I 'gan to pass.' *A principal sent.*
(2) 'Long ere the brightë sun uprisen was.' *Subord. adv. sent.* modifying (1), connected by *long ere*.
(3) 'In which were oakës great (and) straight.' *Adj. sent.* qual. *grove*, connected by *in which*.
(4) 'As a line (*is straight*).' *Adv. sent.* subord. to (3), connected by *as*.
(5) 'Under the which the grass so fresh of hue was newly sprung.' *Adj. sent.* subord. to (3), qual. *oakës*, connected by *under the which*.
(6) 'And (at) an eight foot or nine, every tree well from his fellow grew, with branchës broad, laden with leavës new.' *A subord. sent.* connected with the former by *and*.
(7) 'That sprangen out against the sunnë sheen.' *Adj. sent.* subord. to (6), qual. *leavës*, connected by *that*.
(8) 'Some (*were*) very red.' *Principal sent.*, connected by *and* with foregoing sent.
(9) 'And some (*were*) a glad light green.' *Principal sent.*, connected with (8) by *and*.
(10) 'Which was a right pleasant sight.' *Equal to a principal sent.*, co-ord. with former sentences by *and*.
(11) 'As me thought.' *Interjectional.*

(*d*) PARSING.

ere—conjunctive adv., introducing subord. sent.
uprisen—complete part. of irreg. verb *uprise*, *uprose*, *uprisen*, qual. *sun*.
sprung—complete part. of irreg. verb *spring*, *sprang*, *sprung*, qual. *grass*.
and—co-ordinating copul. conj.
an—art. indef. or adj. qual. the idiomatic expression *eight foot or nine*, equal to *at a distance of eight or nine feet*.
every—distrib. adj. qual. *tree*.
tree—com. noun, neut. sing. nom. subj. of *grew*.
well—adv. mod. the phrase *from his fellow*.
from—prep. gov. *fellow*.
his—pronom. adj. poss. qual. *fellow* (= *its*).
fellow—com. noun, neut. sing. obj. by *from*.
grew—intrans. verb irreg. *grow*, *grew*, *grown*, indicative mood, past tense, 3d pers. sing. agr. with *tree*.
me thought—a species of impers. verb equal to *it seemed to me*.

2.
ought, though now used as a present, is really the past tense of the verb 'owe' in its old sense of 'have,' 'possess.'
must—derived from *moste*, past of O.E. pres. *mot*.
durst—is a present as well as a past derived from (*dearan*), *dyrst*.
better—from O.E. *betera* (from *betan*, to grow well).
worst—from *wyrst* (*weor*, a lost positive).
least—from *læst*.
cunning—from *cunnan*, to know or be able.

Geography.

1. NOTES OF A LESSON ON CENTRAL AMERICA.

Description and Situation.—Central America consists of a long, narrow, and irregular strip stretching from Mexico to the narrowest part of the Isthmus of Panama.

Size.—About 900 miles long, and from 70 to 350 miles broad.

Physical Features.—The mountains of three groups—the Honduras and Nicaragua group, the Costa Rica group, and the Guatemala group; some volcanoes in latter. Centre of country a lofty table-land, with a temperate climate; the coast low, hot, and unhealthy. Rivers of little consequence. The soil is very fertile.

Products.—Indigo, cochineal, mahogany, dye-woods, sugar, and cotton.

The chief industries are agriculture, mining, and cutting mahogany and other woods for exportation.

Divisions.—Guatemala, San Salvador, Honduras, Nicaragua, and Mosquito Coast, Costa Rica, and British Honduras. *Towns.*—New Guatemala, San Salvador, Leon, San José, and Balize.

Population.—Nearly three millions, consisting of Indians, Spaniards, and a mixed race.

Government.—Except in British Honduras—a British colony—the form of Government is republican, each of the five states being independent.

Religion.—Roman Catholic; other Churches tolerated.

Map should be drawn on blackboard.

2. The Indian Ocean, south of Asia, extends from Africa to Australasia, length 4500 miles, breadth 4500 miles. It is cleft

into two parts by India, which parts are called the Arabian Sea and the Bay of Bengal. With the former are connected the Red Sea, Gulf of Aden, Persian Gulf, Gulf of Oman, Gulf of Cutch, and Gulf of Cambay; with the latter, Gulf of Manaar and Gulf of Martaban. Its basin is very important, being the whole of India and Burmah, including the great rivers Indus, Ganges, Brahmapootra, and Irrawady, as well as the Tigris, Euphrates, and the Zambesi. It contains coral reefs and islands. Its most striking feature lies in its periodical winds, called *monsoons*, which are as useful as trade-winds, and have a great effect on the climate of India. They blow from east to west from November to March, but from April to October from south-west. The Indian Ocean is also exposed to tornadoes and to cyclone waves. The main current starts from the Bay of Bengal, sweeps past Ceylon and the Seychelles Islands, and between Africa and Madagascar to the Cape of Good Hope. There it is suddenly checked, and turned to the south-west.

3. The great manufactures of England are those of woven and felted materials, and metals or hardware; and of these cotton, wool, and iron are by far the most important. Next in importance are the manufacture of leather, silk, linen, glass, and earthenware. The various manufactures of beer, spirits, soap, etc., employ a great number of persons.

Cotton manufacture has its chief seat in Lancashire, Cheshire, and the neighbouring counties. Manchester is the centre.

Woollen manufacture has its chief seat in the West Riding of Yorkshire, with Leeds as centre. Broadcloths are made in Gloucester and Wilts. *Carpets* are made in Yorkshire, and at Kidderminster. *Flannels* are manufactured in Wales, chiefly in Montgomeryshire.

Silk manufacture is carried on in London, and also in Cheshire and Lancashire.

Linen is not very important, but the town of Barnsley, in the West Riding, is its chief seat.

The *iron and hardware manufacture* has its chief seat in the south part of Staffordshire, in Shropshire, Derbyshire, and the West Riding of York.

The *leather manufacture* has its chief seat in the counties of Northampton and Stafford, and in London.

Earthenware is made in the north of Stafford, in the district called the 'Potteries.'

Silk used only to be made at Spitalfields. *Woollen* used to be manufactured only at Worsted in Norfolk.

History.

1. The families that have occupied the throne of England from 1066 are :—

(1) Norman	line from	France.
(2) Plantagenet	,,	Anjou in France.
(3) Lancastrian	,,	England.
(4) Yorkist	,,	,,
(5) Tudor	,,	,,
(6) Stuart	,,	Scotland.
(7) Orange	,,	Holland
(8) Hanover	,,	Germany.

2. The chief foreign possessions of the British crown are :—

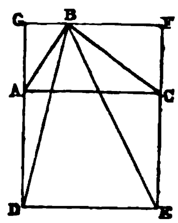
N. America—		
Canada,	acquired	1759–60.
Nova Scotia,	,,	1760.
New Brunswick,	,,	1784.
Brit. Columbia,	,,	1758.
Newfoundland,	,,	1608.
Australia—		
New S. Wales,	,,	1788.
Victoria,	,,	1836.
S. Australia,	,,	,,
W. Australia,	,,	,,
Queensland,	,,	1859.
New Zealand,	,,	1839.
S. Africa—		
Cape of Good Hope,	,,	1806.
Natal,	,,	1824.
Mauritius,	,,	1810.
West Coast Settlements,	,,	1631–73.
Asia—		
India,	acquired	1757.
Ceylon,	,,	1796.
West Indies and S. America—		
Jamaica,	,,	1655.
Bahamas,	,,	1629.
Barbadoes,	,,	1625.
Trinidad,	,,	1787.
Brit. Guiana,	,,	1814.
Honduras,	,,	1670.
Europe—		
Gibraltar,	,,	1704.
Malta,	,,	1800.
Cyprus,	,,	1878.

Composition.

THE DIFFERENCE BETWEEN TRADES AND PROFESSIONS.

In defining the difference between a trade and a profession, it may be stated that the former is a handicraft occupation, and the latter an occupation depending chiefly on study and learning. The professions are acquired by long and laborious application at schools and universities, under professors specially eminent for their knowledge of certain branches of learning; while a trade may be acquired in a workshop or some technical school, under practical masters who have gained their skill by experience in a special line of business. In the case of a trade a certificate of competency is very valuable, and sometimes necessary; but to follow out a profession a diploma of a high order is absolutely required. The different kinds of trades are almost innumerable, and fall under the general term *skilled labour*. But professions are comparatively few on account of the time, labour, and money needed for mastering them; they are almost all comprised under these heads, the *medical*, *legal*, and *clerical professions*, which are sometimes called briefly the *learned professions*.

Euclid.



1. Prop. 7, Book I.
2. Prop. 5, Book II.
3. Let ADEC be a square described on the hypotenuse of the triangle ABC, having B a right angle, and join BD, BE. Then the difference between the squares on BD, DE shall be equal to the difference between the squares on BA, BC.

Through B draw GBF parallel to AC, and meeting DA, EF produced in G and F. Then BG, BF are perpendiculars let fall from B on the bases DA, EC produced, and therefore (by II. 12),

The square on BE = square on EC, square on CB and twice rectangle EC, CF.

But EC = AD and AG = CF, being opposite sides of parallelograms; and therefore by substitution, square on BE = square on DA, square on CB, and twice rectangle DA, AG.

Now square on BD = square on DA, square on AB, and twice rectangle DA, AG; therefore the difference of square on BE and square on BD is equal to the difference of square on CB and square on AB.

Algebra.

1. Dividing by G. C. M. $3x-2$,

$$\text{the lowest terms} = \frac{3x^2+4x+2}{4x^2+x+2}.$$

2. Let x = time in hours.

But by the time second train starts, the first is 80 miles on the way; therefore the equation is

$$40x + 20x = 108,$$
$$60x = 108,$$
$$x = 1 \text{ hour } 48 \text{ minutes};$$

that is, they meet 1 hour 48 minutes after 11, or 12 minutes to 1.

3. (1)

$$7x - 16y = 42, \text{ or } 35x - 80y = 210$$
$$5x + 17y = 30, \text{ or } 35x + 119y = 210$$

By subtracting, $-199y = 0$
$y = 0$ Ans.

Therefore, by substituting 0 for y,

$$35x - 0 = 210,$$
$$x = 6. \text{ Ans.}$$

(2) Multiplying both sides of equation by $8(1-x)^2$, and taking care to change signs when the fractions have the negative sign, we obtain

$$-8 - 7 + 7x^2 = 8 + 8x - 8 + 8x.$$

Transposing,

$$7x^2 - 8x - 8x = 8 - 8 + 8 + 7.$$

Collecting,

$$7x^2 - 16x = 15,$$
$$\text{or } x^2 - \frac{16}{7}x = \frac{15}{7}.$$

Completing square,

$$x^2 - \frac{16}{7}x + \frac{64}{49} = \frac{105}{49} + \frac{64}{49} = \frac{169}{49}.$$

Taking root,

$$x - \frac{8}{7} = \pm\frac{13}{7},$$
$$x = \frac{8}{7} \pm \frac{13}{7},$$
$$x = 3, \text{ or } -\frac{5}{7}. \text{ Ans.}$$

Mensuration.

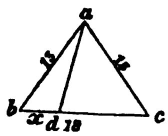
1. Circumference of circle $= 249$ in. $\times 2 \times \frac{22}{7} = 1565$ in.;

therefore $360° : 15° 9' :: 13$ ft. 5 in.
or $21600' : 909' :: 1565$ in.

$$\frac{909 \times 1565}{21600} = 65{\cdot}86 \text{ in.} = 5{\cdot}488 \text{ ft. Ans.}$$

2. This is readily solved by Euclid II. 13.

Let *abc* be the triangle with sides as given. From *a* let fall perpendicular *ad*, and let x=distance *bd*. Then square on *ac* + 2 rect. *cb* . *bd*=square on *cb* + square on *ba*.

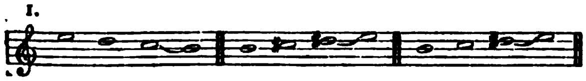


Or $15^2 + 2 \times 18 \times x = 18^2 + 13^2$,
$225 + 36x = 324 + 169.$
$36x = 268,$
$x = 7\frac{4}{9};$

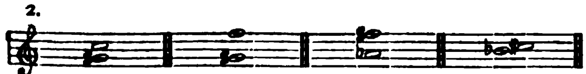
therefore one part $= 7\frac{4}{9}$ ft., and the other $= 10\frac{5}{9}$ ft.

Music.

1.

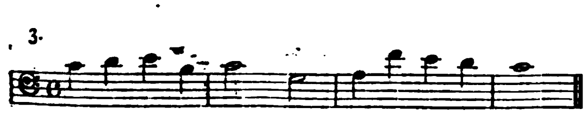


2.



Diminished 4th. Diminished 7th. Augmented 6th. Augmented 2d.

3.



Publications Received.

Algebra—
(1) Algebraic Difficulties Simplified. Stewart.

Arithmetic—
(1) Sonnenschein & Nesbitt's Arithmetic. Sonnenschein & Allen.
(2) Sonnenschein & Nesbitt's ABC of Arithmetic. Sonnenschein & Allen.
(3) Class-Book of Mental Arithmetic. Walker & Co.
(4) Oxford and Cambridge Examination Papers. Stewart.

Botany—
(1) Text-Book of Botany. Sonnenschein & Allen.
(2) Botanical Schedules. Sonnenschein & Allen.
(3) Plants, etc., by C. Baker. Systematic Bible Teachers' Depot.

Drawing—
(1) Brown's Freehand Drawing Copies. Walker & Co.
(2) Lewis's Perspective Drawing Books. Walker & Co.

French—
(1) De Fivas' Guide. Lockwood & Co.
(2) Antoine's French Verb Book. Hughes.

Geography—
(1) Geographical Reader. Standard II. Stewart.
(2) Royal Relief Atlas. Sonnenschein & Allen.
(3) Industrial Geographical Primers: Great Britain and Ireland, France, United States. Sonnenschein & Allen.
(4) Maps illustrative of Cæsar's Gallic War. Sonnenschein & Allen.
(5) Elementary Atlas. Walker & Co.
(6) Slate Paper Projection Atlas. Walker & Co.
(7) Slate Paper Outline Atlas. Walker & Co.
(8) Maps illustrative of Cæsar's 'De Bello Gallico.' With Handbook. W. & A. K. Johnston.

History—
(1) Young Pupil's Historical Remembrancer. John Heywood.
(2) Mangnall's Historical Questions. Hodder & Stoughton.

Kindergarten—
(1) Number Pictures for Nursery Kindergarten. Sonnenschein & Allen.
(2) Child and Child Nature. Sonnenschein & Allen.
(3) On the Connection between Kindergarten and School. Sonnenschein and Allen.
(4) Physical Education of Girls. Sonnenschein & Allen.
(5) The Use of Stories in Kindergarten. Sonnenschein & Allen.
(6) Wasted Forces. Sonnenschein & Allen.
(7) Mutter und Kose Lieder. Sonnenschein & Allen.
(8) Froebel's System of Education. Sonnenschein & Allen.

Mental and Moral Science—
(1) Rylands' Psychology and Ethics. Sonnenschein & Allen.
(2) Elementary Notions of Logic. Sonnenschein & Allen.

Natural History—
(1) Animals: Their Nature and Use. By C. Baker. Systematic Bible Teachers' Depot.

Physiology—
(1) Man: His Frame and Wants. By C. Baker. Systematic Bible Teachers' Depot.

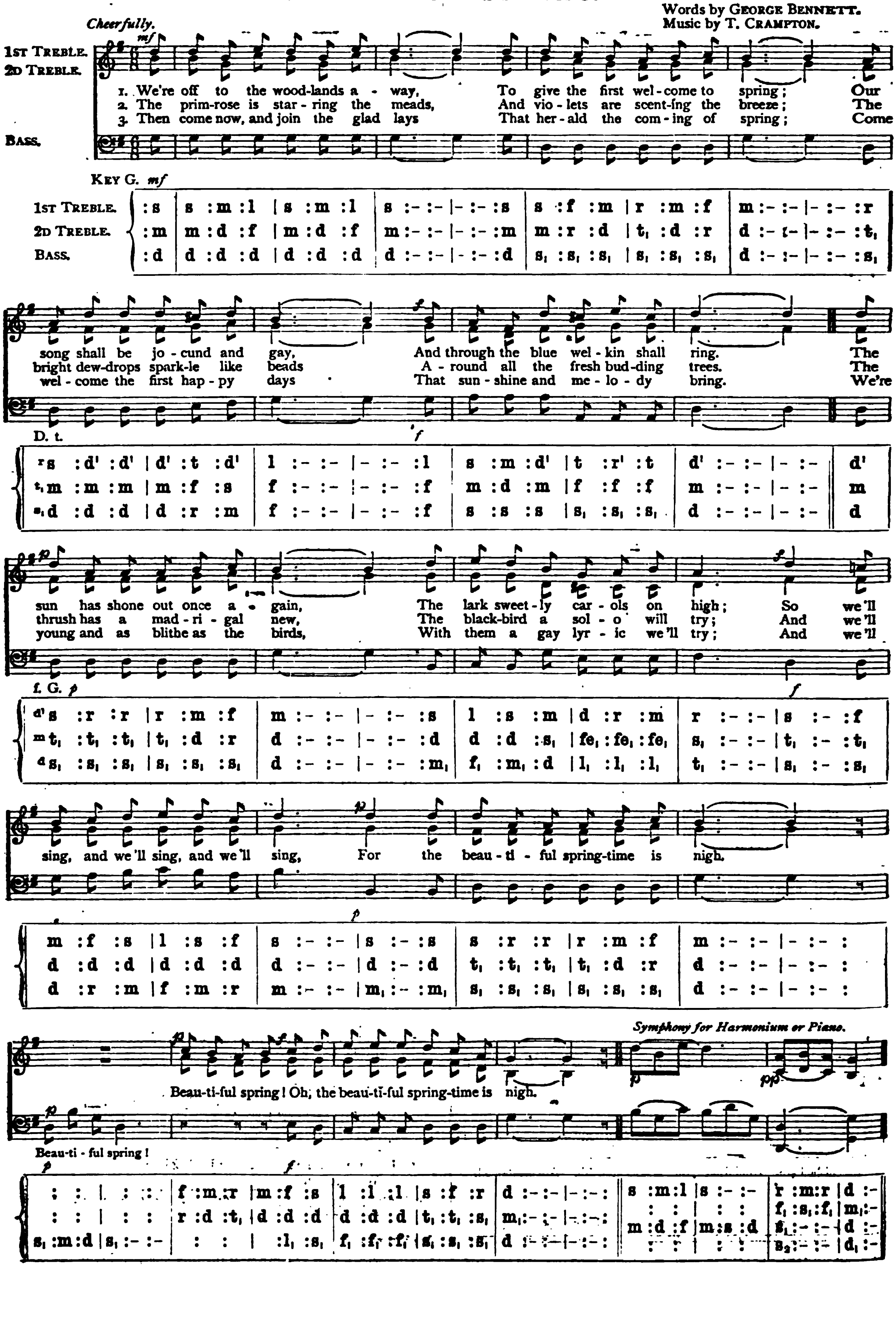
Political Economy—
(1) Social and National Life. By C. Baker. Systematic Bible Teachers' Depot.

School Management—
(1) Lectures on Teaching. By J. G. Zitch, M.A. Cambridge Warehouse.
(2) The Teachers' Handbook. By C. Baker. Systematic Bible Teachers' Depot.

Spelling—
(1) Spelling and Dictation Manual. Walker & Co.

BEAUTIFUL SPRING.

Words by GEORGE BENNETT.
Music by T. CRAMPTON.



Publications Reviewed.

Guide to Modern French Conversation. 224 pp. 18mo. Price 2s. 6d. By V. de Fivas, M.A., LL.D. London: Crosby Lockwood & Co.

This book richly deserves the wide popularity it enjoys. Our friends who have not seen it will thank us for having drawn their attention to this model French *vade-mecum*, and upon examining it, will, we predict, express no surprise that it has reached its twenty-ninth edition. To the tens of thousands who cross the Channel with but a smattering of French, this handy, cheap, clearly-printed, and neatly-bound tourist's companion will prove simply invaluable. We need only add that the same practised hand which wrote the *Grammaire des Grammaires* has penned the text of this useful little volume.

Exercises in Algebra, with Answers. 80 pp. 8vo. 2s. By R. Milburn, M.A. London: Stewart & Co.

Mr. Milburn has in this book collected eight years' (1870–78) questions in Algebra set at the Oxford and Cambridge Examinations. The questions are not printed in 'examinations,' as originally set by the examiners, the wiser plan of graduating the exercises and classifying them under their respective rules having been adopted. The absence of a page of 'contents' detracts from the utility of the book. Candidates will find excellent test-work in this collection of algebraical examples.

Mangnall's Questions. (New edition.) London: Hodder & Stoughton.

This is a new and admirably 'got up' edition of *Mangnall's Questions*. No teacher worthy the name, and skilled in his craft, would, however, stoop to use it. Books of this stamp reduce an otherwise interesting and ennobling study to mere dry mechanical memory-work. The paper, printing, and binding are alike excellent.

Heywood's Young Pupil's Historical Remembrancer. By J. R. Y.

No. 1. Prior to the Conquest.
No. 2. From the Norman Conquest to the Death of Richard III.
No. 3. From the Accession of Henry VII. to the Present Time.

These memory cards are made up into packets of twelve, and published at a shilling. Mr. Heywood has done his part thoroughly well; the cards are stout, well printed, and enclosed in a neat wrapper. We wish we could bestow equal praise on the compiler. On card No. 1 he has put some of the sorriest doggerel that we have ever read. This is the sort of stuff with which he would have the minds of our youth stored:—

> 'Egbert, the first king of all England, was brave;
> But it from the Danes he had trouble to save.
> Ethelwolfe was the second, and he had a son
> Who wanted to take both his kingdom and crown.
> Ethelbald was the third—he did that sad thing:
> Ethelbert was the fourth—our first Christian king.
> . . . .
> Edmund Ironsides was the fifteenth king; he
> Reigned only one year, and was murdered basely.'

We need not add another line.

The Royal Relief Atlas. Price 21s. London: Sonnenschein & Allen.

The title of this work, so far as the maps are concerned, is not a misnomer. If ever atlas deserved the title 'Royal,' this does. The embossed maps are superb, and have the additional merit of not being overcrowded with names. To form an accurate idea of their rare beauty, they must be seen. The descriptive letterpress is meagre, and we fear will injure the sale of the work. We know Mr. Bevan's space was limited, still, in describing our principal river, he could surely have said more than—'The Thames in its course of 200 miles drains the country between the Cotswold Hills and the German Ocean.' We suggest that in future editions the text be enlarged, printed in smaller type, and arranged in two columns. The value of the work as a book of reference would then be greatly enhanced. We trust that when the next prize season comes round, the *Royal Relief Atlas* will find its way into many schools.

The School of Art Drawing Copy-Books.

Freehand in Six Books. Price 3d. each. By Rev. C. J. Brown, B.A.

Perspective in Four Books. Price 4d. each. By Rev. H. Lewis, M.A.

Teachers on the outlook for a series of excellent Drawing Books should examine the set now before us. The careful graduation and suitability of the exercises, the sensible advice which accompanies each figure, and the excellence of the paper combined with the clearness and beauty of the printing, ought to command a wide circulation for these attractive-looking books.

Lectures on Teaching. Price 6s. By J. G. Fitch, M.A. Cambridge University Press.

As we intend in a future number to notice this book at length, we shall now simply remind our readers that Mr. Fitch's admirable Cambridge lectures have been published. It would be impossible to do the author justice within the compass of a few lines. We strongly recommend *every* teacher, and all interested in practical teaching, to buy this book. A manual more helpful to those just entering the profession has not, within our recollection, been issued. No young man or woman can rise from the perusal of it without feeling not only wiser in head, but better in heart.

New Self-Testing Arithmetics. By Thomas Atkins, Head Master of St. James's School, West End, Southampton. London: Joseph Hughes.

Adapted to the very latest requirements of the Code.

Atkins' Standard Arithmetics. In six books for the six Standards, price 1d. each; complete, price 6d., strongly bound in cloth, to stand school wear. Answers to all the Standards, price 6d. cloth; complete Arithmetic, with Answers, price 1s. cloth. London: Joseph Hughes.

The arrangement of the sums renders the book unsurpassed for—

(*a*) Preventing copying.
(*b*) Examination purposes.
(*c*) Setting Home Lessons.

The Answers to the first five Standards are self-testing.

A Practical Course of Arithmetic. Adopted by the London School Board. By Joseph Hughes, F.R.G.S., formerly Principal of Pomfret College; author of 'Graduated Exercises in Arithmetic,' 'Easy Problems for Young Thinkers,' etc.

Standards I. and II., each 1d.; III., IV., V., and VI., each 2d. May be had in cloth at 1d. per part extra. Answers, 6d. each part; complete, with Answers, 2s. 6d. London: Joseph Hughes.

Hughes's Infant-School Arithmetic. Fourth Edition. Price 1d.; cloth, 2d. Answers, strongly bound in extra cloth, 6d. London: Joseph Hughes.

This little Manual, which has been expressly written for Infants, is the only one of its kind extant. It contains a large collection of examples, thoroughly suited to the capacities of very young children.

Several well-known Infant Mistresses have adopted this little book, and speak of it in most gratifying terms.

Arithmetical Tables.

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Arithmetic.

STANDARD I.

(1)	(2)	(3)	(4)
679	859	3729	309070408
540	294	9283	6
19			
704			
900			

STANDARD II.

(1) From 74703
Take 58097

(2) Multiply 56927 by 459 (*boys*) / 37 (*girls*)

(3)
3520
1099
19078
20604
1000

(4) Divide 36994 by 8 (*boys*) / 5 (*girls*)

(5) A man had 250 apples. He sold 6 each to 7 boys. How many left?

STANDARD III.

(1) Divide 6 millions 6 thousand and six by 72 (*girls*) / 346 (*boys*)

(2) Add together 6s. $4\frac{1}{2}$d.; £3002, 0s. $8\frac{3}{4}$d.; $9\frac{1}{4}$d.; £5, 19s. $11\frac{3}{4}$d.; 17s. $0\frac{1}{2}$d.; £10,764, 18s. $9\frac{1}{2}$d.; £964, 17s. $8\frac{1}{4}$d.

(3) Take £2, 16s. $0\frac{1}{4}$d. from £1000, 0s. 1d.

(4) A tailor made a suit of clothes, the cost of which was for cloth, £1, 12s. 6d.; thread, $2\frac{1}{2}$d.; buttons, 1s. $3\frac{1}{4}$d.; wages, 19s. $11\frac{1}{2}$d. He sold the suit for 4 guineas. What profit did he make?

STANDARD IV.

(1) How many minutes in July and August?

(2) Reduce 20,000 minutes to weeks.

(3) Find cost of 13 pieces of cloth, each 60 yards, at 1s. $11\frac{1}{2}$d. per yard.

(4) Reduce 7 miles 2 fur. 219 yds. 2 ft. to feet.

(5) Reduce $2\frac{1}{2}$ furlongs to feet.

(6) The expenses of an entertainment amounted to 5 guineas. Find the profit, if there were sold 329 tickets at 1d. each, 250 at 3d., and 100 at 4d.

(7) 3 barrels of sugar, each 4 cwt. 3 qrs., are weighed into 1 lb. parcels. How many parcels?

(8) A clothier bought 57 overcoats at £3, 12s. 6d. each. How much did they cost him?

(9) Divide £19,993, 17s. $9\frac{1}{4}$d. by 49.

STANDARD V.

(1) A woman bakes 2 stones of flour every 4 days. How much flour would she bake in 8 weeks 2 days?

(2) Find cost of 967 articles at 1s. $7\frac{1}{2}$d. each.

(3) 7 antimacassars took 6 oz. of wool each. Find cost at 5s. 8d. per lb.

(4) Calculate and receipt the following bill:—

3 stones of flour at $2\frac{1}{2}$d. per lb.
16 oz. of cloves at 4s. per lb.
2 lbs. of nutmegs at 2 oz. for $1\frac{1}{2}$d.
6 oz. pepper at 1s. 4d. per lb.

STANDARD VI.

(1) If 25 men do a piece of work in 24 days of 8 hours each, how many hours a day would 30 men have to work 16 days to do the same?

(2) $\dfrac{3\frac{1}{3}}{1\frac{3}{16}} \div \dfrac{6\frac{2}{3}}{2\frac{5}{8}}$.

(3) £4, 16s. $10\frac{3}{4}$d. $\div$ 3·25.

(4) Find the difference between $\dfrac{2\frac{1}{3}}{5\frac{5}{6}}$ and $\dfrac{3\frac{5}{6}}{1\frac{1}{12}}$.

(5) Find the value of $\frac{3}{4}$ guinea + $\frac{3}{5}$ crown + $\frac{5}{6}$ of 7s. 6d. − $\frac{3}{4}$ of 2d.

(6) If 8 oz. cost ·5625 of a shilling, what will ·75 of a ton cost?

Domestic Economy.

STAGE I.

A.

1. What do you understand by food? Name the three chief offices which food performs.
2. Describe fully the roasting of a joint of meat.
3. Describe how soups are made. Do you know how broth is made for a working man and his family?

B.

1. Give a definition of Domestic Economy.
2. What is the best flesh for roasting?
3. What is best suited for salting?
4. What are the fattest kinds of food?

STAGE II.

A.

1. Name furniture and utensils for a bedroom, and give the prices if you can.
2. Tell how to scrub a kitchen floor.
3. What would you purchase if you were asked to furnish a kitchen?

B.

1. What is a dust-bin? How could you get rid of it in the household?
2. How would you proceed to light a parlour fire?
3. What would you use to take ink out of a table-napkin?

STAGE III.

1. How would you warm and ventilate a sick-room?
2. What is a sprain? How would you dress it?
3. How would you keep the sick-room quiet?

Monthly Notes.

THE SCHOOL BOARD FOR LONDON is the most important educational body in London, we may say in the world, if its importance be measured by the scale of its operations. The estimate of its probable expenditure during the year from the 25th of March 1880 to the 25th of March 1881 has just been put into the hands of the members. This estimate gives a total for the year of £724,870, being an increase on that estimated last year of £71,507. The sum of £48,291 will remain as a surplus at the close of this year; this being deducted from the sum required for the ensuing year, will leave the sum of £676,579 to be levied by precept. For the current year the average attendance of pupils is estimated at 196,704, the cost per pupil being 34s. 3d. For the ensuing

year it is calculated that the average of pupils will be 224,014. The Board has resolved to employ an additional inspector, which will bring its inspectorial staff up to seven, each having the inspection of schools containing about 30,000 children. Like the House of Commons, the Board has also deemed it necessary to effect considerable modification of its rules of procedure in order to prevent the obstruction of its operations.

THE TEACHERS' REGISTRATION BILL.—This bill, which 'purports to have been prepared and brought in' by Sir John Lubbock, and which has also on the back of it the names of Mr. Playfair and Mr. Balfour, is at the present time one of the subjects in which educationalists are chiefly interested. The bill waits the second reading; meanwhile it is being earnestly studied and discussed by the various educational bodies. It was the chief subject of discussion at the Annual Conference of the Teachers' Association, which was held in the Theatre of the Society of Arts, on Friday, January the 7th. A resolution was passed approving of the principle of the bill. But in its present form elementary teachers are excluded from the proposed registration, and this part of the bill was hotly opposed by Mr. Heller and Mr. Grove, on the part of the National Union of Elementary Teachers; ultimately a resolution was carried, with but few dissentients, 'That elementary teachers be admitted to the register.' The bill was also discussed at the January meeting of the Convocation of the University of London. The number present, however, was unusually small, in consequence of the inclemency of the weather. It was therefore agreed that the discussion should be adjourned. In the present state of business in Parliament there is no chance of an opportunity for a second reading being obtained for some time.

THE ANNUAL MEETING OF THE ASSOCIATION OF PRINCIPALS OF PRIVATE SCHOOLS was held at Anderton's Hotel on the 11th of January. The principal business was the discussion of a paper by Mr. J. Stewart on 'Examination for Secondary Schools.' There was a general agreement of opinion that the bill about to be brought in by Sir John Lubbock should make some arrangement for such examinations.

THE annual meetings of two important London educational institutions were held during the first month of the year—the City of London College, and the Birkbeck Institution. The former is doing a great work among young men occupying situations in the City especially; the other is no less useful to a certain extent among the same class, but especially among the higher class of artisans. Both institutions stand much in need of more commodious premises and larger resources. The City of London College has secured a site and a portion of the money required for this purpose.

THE EDUCATION CODE for the current year was laid on the table of the House of Commons on Thursday the 3d February. No changes have been made on that of the past year, except in the article of half-timers, which has been modified to meet the requirements of the Act of last year. The Department hope, however, later in the season, to lay on the table a minute embodying changes, which will be well considered, with a view to simplifying the Code and securing the best results, and which they hope to introduce into the next year's Code.

THE COLLEGE OF PRECEPTORS held the public distribution of prizes and certificates awarded to candidates at the Christmas examination, at the Memorial Hall, Farringdon Street, on Wednesday, February the 16th. The Right Hon. Lord Norton occupied the chair. The monthly meeting of the members was held at the College rooms on the evening of the same day, when a paper was read by David Nasmith, Esq., LL.B., on 'Economic Methods of Teaching.' An interesting discussion took place after the lecture.

TEACHERS' ASSOCIATIONS.—The quarterly meeting of the West Lambeth Association was held in Gideon Road Board School, on the 5th of February. There was a very large attendance. Thirty new members were elected, making the total 230. Business connected with the ensuing Conference of the Union was transacted, and a resolution was passed affirming that 'Training colleges should be open to all Queen's scholars fulfilling the Government requirement.'—The quarterly meeting of the Southwark Teachers' Association was held in Webb Street Board School, on Saturday the 12th February. Business connected with the ensuing Conference was transacted. A paper was read on 'Thrift' by the Rev. John Sinclair, formerly member of the School Board; and Mr. T. Heller delivered a short address, pointing out desirable amendments on the Teachers' Registration Bill. There was a very fair attendance.

Engagements for March.

Mar. 1.	Gresham Lecture, Rhetoric, . . .	6 p.m.
2.	Society of Arts, 'Flashing of Signals for Lighthouses.' Sir William Thomson, . .	8 p.m.
	Gresham Lecture, Rhetoric, . . .	6 p.m.
3.	London Institution, 'The Production of Electricity.' Professor W. E. Ayrton, . .	7 p.m.
	Gresham Lecture, Rhetoric, . . .	6 p.m.
4.	Society of Arts, Indian section, 'The Results of British Rule in India.' J. M. Maclean,	8 p.m.
	Gresham Lecture, Rhetoric, . . .	6 p.m.
	London Institution, 'Electricity viewed as possibly a Mode of Motion.' Sir William Thomson, ...	7 p.m.
5.	Working Men's College, 'Dr. Johnson.' Leslie Stephens, M.A., . . .	8 p.m.
7.	London Institution, 'Vulgarisms.' Mr. E. B. Nicholson, ...	5 p.m.
	Victoria Institute, 'Language, and Theories of its Origin.' R. Brown, F.S.A., .	8 p.m.
	First Grade Drawing Examination (about).	
8.	Anthropological Institute, . . .	8 p.m.
	Society of Arts Examination, Arithmetic.	
9.	Society of Arts, 'Improvements in the Treatment of Esparto in the Manufacture of Paper.' W. Arnot, F.C.S., . .	8 p.m.
	Society of Arts Examination, History and Geography.	
	The Geological Society of London.	

(*For continuation, see page* 44.)

Mar. 10. London Institution, 'The Prospects of Architecture in Modern Civilisation.' Mr. William Morris, ... 7 p.m.
Society of Arts Examination, English and Music.
Darlington College Annual Meeting.

11. Royal Institution, 'The Language and Literature of the Scottish Highlands.' Professor Blackie, F.R.S.E., ... 8 p.m.
New Shakespeare Society, '*The Tempest* founded on an Older Play.' Brinsley Nicolson, M.D.
Home and Colonial Teachers' Meeting.

12. Working Men's College, 'What History teaches.' William Moore, M.A., . 8 p.m.
Derby District Union and East Lancashire (Teachers') Annual Meeting.

14. London Institution, 'The Gold and Silver Mines of the World.' Mr. G. Phillips Bevan, 5 p.m.
Geographical Society of London, . . 8.30 ,,

15. Society of Arts, Foreign and Colonial Section, 'The Loo-Choo Islands.' Consul J. A. Gubbins.

16. Society of Arts, 'The Manufacture of Aërated Waters.' S. P. Bruce Warren, . . 8 p.m.
College of Preceptors, 'Teaching English Literature in Schools.' H. C. Boven, Esq.

17. London Institution, 'The Combination of Voices with Instruments.' Dr. W. H. Stone, 7 p.m.

18. Royal Institution, 'Musical Pitch and its Determination.' W. H. Stone, M.D., . 8 p.m.

Mar. 19. Working Men's College, 'The Gold and Silver Mines of the World.' Mr. G. Phillips Bevan.
North Gloucester (Teachers') Association Annual Meeting.

21. London Institution, 'Fungi.' Prof. Bentley, 5 p.m.
Candidates for Science and Art Department apply for admission to sit before March 25.
Victoria Institute, paper by J. F. Bateman, Esq., F.R.S., ... 8 p.m.

22. Anthropological Institute.

23. Society of Arts, 'The Increasing Number of Deaths from Explosions, with an Examination of the Causes.' Cornelius Watford, . 8 p.m.
Geological Society of London, . . 8 p.m.
Apply for Examination of Schools receiving Aid from Science and Art Department, March 31 last day (Form 119).

24. Society of Arts, Applied Chemistry and Physics Section, 'The Future Development of Electrical Appliances.' Professor Perry, 8 p.m.
London Institution, 'The History of the "Suite."' Illustrated Musical Lecture, . 7 p.m.

25. Society of Arts, 'The Tenure and Cultivation of Land in India.' Sir George Campbell, R.C.S.I., ... 8 p.m.
Royal Institution, 'The Weather and Health of London.' Alexander Buchan, Esq., M.A., F.R.S.E., ... 8 p.m.

26. Working Men's College, 'Aristotle's Idea of Happiness.' R. C. MacClymont, M.A., . 8 p.m.
Manchester District (Teachers') Union Half-yearly Meeting.

28. Geographical Society, . . . 8.30,,

31. Last day for sending in Science Form 119.

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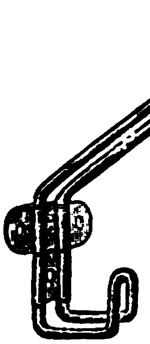

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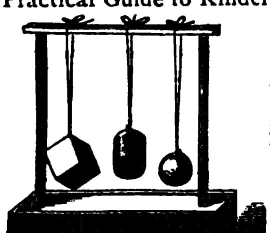

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Health at School.

No. II.—SITE OF SCHOOL.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),

President of the Council of the British Medical Association.

HAVING made a few introductory remarks for the purpose of showing the wider scope of the subject of 'Health at School' than is generally understood by the term, and having pointed out that there is something to be done besides preventing the extension of infectious disease among school children, or even the prevention of that kind of disease which arises from the mere aggregation of numbers in close quarters, I will now proceed to discuss the particular points towards which attention should be especially directed. It must be borne in mind that the class for whom we are providing are of that age which is peculiarly susceptible to the influence of bad hygienic surroundings, and that it is especially necessary that a school-house should be constructed on the best possible hygienic principles. These in the first place resolve themselves into questions connected with the site of the school buildings and their immediate surroundings, such as—(1) their position with regard to other buildings and land in close proximity to them, and other portions of the same district; (2) the level of the land upon which they are placed; (3) the nature of the soil itself, especially that of the mother or virgin earth, the term virgin being applied to ground which has not been previously disturbed, at least in historic times; (4) the condition as to natural drainage, or the ordinary level of underground water.

It should be a *sine qua non* that no school-house should ever be built upon ground which has been raised from some former level, or has been 'filled up' with soil containing organic matter. Holes (either in the past or present) with notices up that 'Dry rubbish may be shot here' should be religiously avoided. If from the very nature of things it is utterly impossible to get any other site, then the whole of the superadded earth should be taken out down to the level of the virgin soil; for we have to consider the atmosphere which is likely to pervade the subsoil, as well as that of the air above the so-called *terra firma*.

This view of the subject is intimately associated with the level of the ground water in the subsoil. These points are connected with situation, and if not taken into account, may seriously interfere with the proper ventilation of the school, and render good health impossible. The nature of the materials with which the school is to be erected, and the elevation at which the school-house should be placed from the ordinary level of the earth, are also to be taken into account. I have seen the organic matter removed in a great measure, and the excavation used as a playground beneath the building, without any provision being made for the removal of the ground air from the hole. That ground air has been, from the very nature of circumstances, about the worst that it was possible to provide for the children to inhale. In that case, one evil was removed, but not the other. The soil around teemed with organic debris, and as a consequence deteriorated the atmosphere of the pit rather more than it was before the subsoil was taken out. In the one case the debris occupied a portion of the room, and the sum total of carbonic acid was rather less in the ground air before removal than after. It would have been better to have built upon it than only excavate. Certain kinds of materials used for construction, and some kinds of arrangements in the building of schools, render them much more capable of being effectually ventilated and warmed, as well as of being kept perfectly dry, than others in which different plans have been adopted, and the suggestions now made are some of them intended to promote the more easy and less expensive plans which will have to be adopted for proper warming and ventilation.

Returning to our subject of site, we must look at it in two ways:—(1) The choice of a site for a new school when the choice is open to us. (2) The way in which to diminish to the smallest possible amount the evils which must be endured, and to decrease the effects of their incidence in any particular case when no really satisfactory site can be obtained.

We have to find out (1) the nature of the subsoil and the quantity of organic matter which it contains, whether it is so-called 'made ground;' (2) the

level at which the subsoil or ground water ordinarily stands with regard to the surface, whether it is constant in its position, or varies much with the seasons, or is influenced by other causes. No school ought to be erected on any particular site until these points have been satisfactorily settled. If the line of the ground water rises and falls at frequent intervals, be the subsoil what it may, it cannot be a satisfactory site for a school; and if, in addition to this rise and fall of the ground water, the subsoil is organic in its nature, or is likely to be invaded by water containing organic matter in suspension or solution, it will be quite impossible by any arrangements whatever to prevent that school, at times, from being invaded by impure air, and thus presenting to the children assembled therein, or at least in the playground surrounding it, an atmosphere which will tend to diminish their general health.

Before settling upon a site for a school, if these points cannot otherwise be certainly determined, trial holes should be dug until the level of the ground water line is reached, unless the proposed site is a rock or in such a position that no ground water is likely to be found within a considerable distance from the surface. The level of the water line should be watched, and it should be noted if it be stationary or not, for in some districts this water line is found to vary very constantly.

The trial hole will also inform the promoters as to the character of the subsoil. The condition of the ground air is almost as important as that of the atmosphere around the school. It is a point which is not usually considered, and yet it is certain that the condition of the air in the subsoil will materially influence the health of the children. The quantity of air below the level of the soil will be more or less according to the porous nature of the soil itself; it will be in many cases equal to half the volume of the soil. When the level of the ground water rises, the air is naturally displaced upwards; and if the soil in which the air has stagnated be loaded with organic matter, it will be so altered from its natural character as to seriously and injuriously affect the children exposed to its influence.

The air in the subsoil is comparatively stagnant, and whilst that above ground only contains at the most four parts in 10·000 of carbon dioxide, that which is taken from below the level of the soil will often contain 4 p. c. or even 6 or 8 p. c. of that deleterious gas. This is one of the results of stagnation: the oxygen is removed, organic matter is oxidized, and carbon dioxide (or carbonic acid, as it is more commonly called) takes its place. Stagnation is the bane of health, and whether it be in air or in water, stagnation allows time for adulteration with injurious compounds. Such is the case with ground air: there is always a much greater quantity of carbon dioxide in it than in natural air. It forms an atmosphere which is very beneficial to the vegetable kingdom, but is just as injurious to human life. This impurity is much greater in the ground air than in the ground water; it will vary according to the nature of the subsoil, and whatever organic matter may exist in the latter, the whole will in the course of time be reduced to simpler elements of which carbon dioxide is sure to be one. Thus it happens that the more organic matter a given subsoil contains, the more injurious it is for that subsoil to be allowed to remain beneath the floor of any school buildings. If from the very circumstances of the case it is necessary for some such to be left *in situ*, arrangements must be made to disperse those products into the surrounding atmosphere, and to prevent them from finding their way within the area which is enclosed by the walls of the buildings. It is for this reason that it is far better for playgrounds to be turfed than covered with gravel. The vegetable kingdom is the natural protector against excess of carbon dioxide in the air.

It is important for all reasons that the level of the ground water should be uniform when it is less than fifteen feet from the surface of the earth. This uniformity can be effected, at least as regards a rise above a given level, wherever there is any regular system of drainage at hand. But it sometimes happens that a considerable extent of ground has the subsoil water raised by occasional inundations by reason of unusually wet seasons and from imperfections in natural drainage. There is always a slow movement of this water in the earth, but not sufficiently rapid to prevent the oxidation I have mentioned. It brings with it impure organic matters from a distance, and if in its progress it comes into contact with a mass of matter more than ordinarily dry, such as must exist beneath the area of any large building, the very part in which the most injury can be done is precisely that part which attracts the larger portion of organic matter from the water; and as the water line subsides, it leaves its organic matter behind it, and lays the foundation for future evils which are totally unsuspected. These underground inundations produce results which correspond with those which arise in recently-drained districts. It is only within the last few years, partly by observations in this country, but more decidedly by those made in Munich and in America, that the influence of ground air and ground water upon the public health has been demonstrated to be great. A few years ago our soldiers had frequently to live on the basements of their barracks, with the natural result of ill health and high mortality, and it is only recently that the occupation of cellars as lodging-houses has been prohibited by law.

If the level of the ground water line is moderately constant, even if it be within a few feet of the surface of the land, it is not nearly so injurious as when it rises and falls occasionally. This explains some of those anomalies which occasionally surprise us. It is sometimes seen that some places in which the level of the water is always within two feet of the surface are more healthy than others which are farther from the banks of a given stream. Those districts which have the misfortune to be placed above and yet within the influence of a mill-dam in a porous soil, especially when the mill-lead belonging to it does not rapidly fill, are much more unhealthy than those placed below the dam, and where the level of the ground water does not vary, although apparently it is the moister position of the two. The permanent level of the subsoil water should be kept as low as possible, and the soil should be so arranged (if it be porous), by means of subsoil drainage, that air should have free admission to it.

Evil results are more marked in a sandy or gravel soil, when these matters are not attended to, than in those sites in which the soil is more retentive. If

the level of the ground water cannot be regulated, it is better to choose a more retentive soil; but if soakage does take place, it is much more difficult to remove it from an argillaceous or retentive soil than from sand or gravel: the former also will be colder than the latter, from the continuance of evaporation, and then the cost of warming will be increased.

Anecdotal Natural History.

No. II.—THE CAMEL.

BY REV. J. G. WOOD, M.A., F.L.S.,

Author of 'Homes without Hands,' 'Nature's Teachings,' etc.,

AND THEODORE WOOD,

Joint Author of 'The Field Naturalist's Handbook.'

THE place of the horse is supplied, and more than supplied, in the East by the Camel, the 'Ship of the Desert,' as the Arabs poetically term it, whose structure is singularly adapted to the nature of the country which it has to traverse. A horse could not pass through the sandy deserts, beneath the fierce heat of a tropical sun, bearing the heavy load of the camel, and dispensing almost entirely with food and water, especially the latter, for days together; and would, in fact, find it by no means easy, even if entirely unencumbered, to make its way through the treacherous soil, in which it would sink for several inches at every step. But the camel has evidently been constructed with an especial view to the exigencies of the desert traffic, and can therefore perform work which would be quite impossible to any other animal.

Halt in the Desert.

There are two species of camel, the chief of which is the true camel of Arabia, bearing one hump only upon its back. This is the animal most in use as a beast of burden. The second species, the Bactrian camel, or Mecheri, which possesses a second hump, is almost entirely used for riding purposes.

Now, when we consider the nature of the soil over which the Arabian camel has to pass, it is evident that there must be some provision in the foot of the creature in order to enable it to find a firm foothold. So, instead of the single hard hoof which is found in the horse, the foot of the camel is provided with two broad toes, furnished with large, soft, and very elastic cushions beneath, so as to afford a large surface, and prevent the animal from sinking in the loose sand.

Then, as the animal must be loaded and unloaded when in a kneeling position, the knees and breast are furnished with thick callous pads, so that the skin is not injured by the contact with the rough ground.

A curious part of the structure of the camel is found in the hump, which is not, as many think, a malformation of the back, for the spine is as straight as that of any other animal, but is merely a fleshy and fatty protuberance, connected in some strange way with the health of its owner. The Arab always judges the state of his camel by the hump, and will not allow the animal to start upon a long journey unless the hump is in perfect condition.

The chief use of the hump seems to lie in its power of nourishing the animal when other food is scarce. During a long desert journey, for example, the camels are very sparingly fed, and appear to subsist upon the nourishment derived from the hump, which gradually diminishes in size, until at the end of the journey it is scarcely visible, not regaining its former proportions until after two or three months of careful feeding.

In a somewhat similar manner, the hibernating animals exist without food for several months. They accumulate a quantity of fat largely in excess of the normal amount, and by the absorbing of the superabundant fat into the body, are enabled to supply the waste of tissue.

Another noticeable point in the structure of the camel is to be found in the formation of the eyes and nostrils, the former of which are provided with long lashes, while the latter can be closed at will, thus preventing the admission of grains of sand during the storms so common in the desert.

Perhaps the most extraordinary part of the formation of the camel lies in its power of storing up sufficient water within the stomach to last it for several days without again drinking. To understand this properly, we must enter somewhat more carefully into the details of the internal anatomy.

Like that of the sheep and other ruminating animals, the stomach of the camel is divided into no less than four portions, which, though each is a separate cavity, are connected with each other. Into the first and largest of these, usually known as the paunch, or *rumen*, the food passes as soon as swallowed, and before it is masticated. There it remains until a convenient opportunity arises for chewing it, when it is returned to the mouth and thoroughly macerated. Before this process takes place, however, it passes into the second stomach or *reticulum*, which consists of a number of polygonal cells, in which the food is formed into a number of smooth balls. This is the 'honeycomb tripe' of butchers. Thence it is expelled into the œsophagus, or gullet, which opens both into the

first and second stomachs, and is carried by the contraction of the spiral muscles composing that tube into the mouth, where it is masticated at leisure.

As soon as it is thoroughly chewed, the food is once more swallowed, and this time passes directly through the first and second stomachs into the third, or *psalterium*, the walls of which are composed of very numerous folds, not unlike the leaves of an uncut book. This is the 'manyplies' or 'manyplus' tripe of butchers, presenting a very large surface to the food which is here prepared for admission to the fourth stomach.

This, which is scientifically known by the name of *abomasus*, and by butchers called the 'red,' is the true digestive stomach, the other three being only employed in the prior preparation of the food. In this division of the stomach the gastric juice is secreted. In the calf it is called 'rennet,' and is used for curdling milk in the preparation of cheese.

While the animals of this class, the Ruminants, are still young, and are fed by their mother's milk, the fourth

Arabian Camel.

stomach only is fully developed, the other three not being required until the animal is old enough to find its nourishment in vegetable substances.

This structure is common to all the ruminating animals, but in the camel there is found to be a still further development. The polygonal cells which are found in the reticulum, and in part of the paunch, are very large in proportion, and are surrounded by muscular bands, enabling them to be closed at will, their contents not mingling with the food contained in the stomach. In these cells is reserved the water drunk by the animal, a small quantity of which can be released and allowed to flow into the stomach as occasion requires, the rest remaining in the reservoirs until needed. By this arrangement a camel is able to store up sufficient liquid for six or seven days, a provision of the greatest service in crossing the hot arid desert where water is unprocurable.

It would seem that by practice the camel is enabled to store away a larger quantity of water than had previously been the case, for an old and experienced animal will contrive to lay up half as large again a stock as it could when young and unused to desert travelling.

It has sometimes happened in a caravan that the water has run short, and the only alternative has been to kill some of the camels in order to obtain the water contained in their stomachs. It is then found to be of a pale greenish colour, and very unpleasant to the taste. Yet it is preferable to dying of thirst, and is really hardly more disagreeable than the water contained in the leathern bags carried on the camel's backs, which is heated by the sun, besides tasting very strongly of the tar with which the seams are dressed.

This structure presents a singular analogy to the blood-reservoir of the whale, by which it is enabled to spend a considerable time beneath the surface of the water. A large supply of blood being purified and aerated in the lungs, is stored away in a mass of blood-vessels set apart for that purpose, whence a portion is introduced into the circulatory apparatus as it is from time to time required. But for this provision the whale could never spend more than two or three minutes together beneath the surface of the water, the air or aerated blood being quite as necessary to its existence as the water is to that of the camel.

Of the two species of camel, the Arabian is by far the more valuable, being both stronger and more enduring of privation and fatigue than its Bactrian relative. The load of the Arabian camel is usually from five to six hundred pounds in weight, this being the average amount that the creature can carry with ease. It is by no means a swift creature, its pace seldom exceeding two miles and a half in the hour, and often not coming up to even that standard. There is a swifter breed, usually known as the Dromedary, which is chiefly kept for the saddle, and which can keep up a pace of eight or nine miles per hour for twenty hours at a stretch, being to the camel what the racer is to the cart-horse. The motion of the camel is most unpleasant to any one riding it, for it moves both legs of each side together, progressing at a long swinging trot, and jolting its unfortunate rider in the most unmerciful manner. Novices in camel-riding almost always suffer from sickness as badly as if they were in a Channel steamer on a rough day. With some of the faster dromedaries it is even necessary for the rider to swathe his body, from the hips to the arms, in bandages drawn as tightly as possible, before he commences his journey.

There is a mistaken idea that the camel is a very patient, gentle, and docile animal, and that he is very easily managed. In reality, the case is just the reverse, for a more quarrelsome, unruly, and revengeful animal hardly ever existed. No sooner is he unloaded than he begins to fight any of his fellows who may be in the neighbourhood; the loading and unloading are never performed without much trouble, and many savage grunts on the part of the camel, and when fairly loaded, his first endeavour is always to get free of his burden, or, failing that, to ruin every article included in it.

Then, at night, when it is time to unload, the cross-grained animal has to be compelled to kneel by main force, and his head tied to his fore legs in such a manner that he cannot rise until the proper time. An experienced traveller says that he has never yet seen a camel in anything but a bad temper, at any rate, to judge by appearances.

Besides its use as a beast of burden, the camel is of service to its masters in various other ways. Its milk, for example, is a standard article of food, and is mostly kept until quite sour, the Arabs considering it to be then a much greater dainty than when it is sweet and fresh. A very inferior kind of butter is churned from the cream by pouring it backwards and forwards in a goatskin for a certain time.

The flesh of the camel is considered a great dainty, but is very seldom eaten, owing to the value of the animal. Occasionally, however, a rich Arab will kill one of his camels, and invite all his friends to a feast, at which the flesh of the slaughtered animal appears as the crowning delicacy.

Water Cells in Camel's Stomach.

At certain times of the year the camel sheds its hair, which is collected, and being spun into thread, is used in making garments. Certain portions of it are also utilized for the 'camel's hair pencils' used by artists.

THE two-humped or Bactrian camel, which is found

Bactrian Camel.

throughout Central Asia and China, though now almost entirely used for the saddle, was at one time put to a very curious use. The East India Company formed a regiment of these animals, each being provided with a couple of swivel guns, placed between the humps, and managed by the rider. This company was known as the camel artillery, and was sometimes of considerable service.

The colour of the Bactrian camel is darker than that of its Arabian relative, varying from dark brown to a sooty black in hue.

THOUGH the true camels are exclusively confined to the Old World, a closely allied genus, comprising four species, is found in America. These animals are popularly known by the name of Llamas, and differ in many respects from the true camels.

In the first place, the toes of the foot, instead of being connected, as in the camel, are separated, and can be extended at will. This is on account of the rocky and mountainous nature of the localities which they inhabit, and in which the power of moving the toes is necessary in order to give them a firm foothold. All the Llamas are of very much less size than the camel, the Guanaco, the largest, not standing much more than three feet six inches at the shoulder. The hair is long and woolly, and the general aspect of the animals is remarkably like that of an overgrown sheep.

The four species are the Vicugna, the Guanaco, the Yamma, and the Alpaca. The first of these is found in the most mountainous parts of Northern Chili and Batavia, and is valuable on account of its skin, which causes it to be much sought after. In other ways it is entirely useless, as from its wild and untameable nature it cannot be employed as a beast of burden. In colour it is brown, approaching to grey beneath; the height is about two feet six inches at the shoulder.

The Guanaco, which is found in the more northern regions of Patagonia, is of a reddish-brown colour, the ears and hind legs being grey, and stands about three feet and a half at the shoulder. It lives in herds, varying from ten to forty or more in number, and like the sheep, under the guidance of a single leader, whose orders are always implicitly obeyed. Should this leader be killed or trapped, the flock seem perfectly bewildered, and wander vaguely from place to place, laying themselves open to easy capture by the hunters. The sense of curiosity is very strongly developed in the Guanaco, which, though naturally a wary and timid animal, can be brought within a short distance of a hunter if he lies on his back on the ground and

kicks his legs in the air. It is able to swim well, and has often been known to take voluntarily to the water and swim from one island to another.

The Yamma, or Llama, which was formerly used as a beast of burden by the Spaniards in America, is of a variegated brown colour, with long and slender legs. It is now little used in any way, the sheep having replaced it with regard to the wool supply, and its flesh being dark and coarse and seldom eaten.

The fourth species, the Alpaca, or Paco, as it is sometimes termed, is, together with the last-mentioned animal, sometimes thought to be only a domesticated variety of the Guanaco. It is a valuable creature on account of its wool, which is long and silky. A herd of Llamas was even imported into Australia, where it flourished fairly well, yielding a large supply of the valuable wool.

Short Historical Anecdotes.

BY REV. SIR GEORGE W. COX, BART., M.A.

(11) The Greek Prize of Victory.

WHEN some Arcadian deserters asked to be admitted into the service of the Persian king, Xerxes asked them what the Greeks were doing. The answer was that they were keeping the great feast of Olympia, and beholding the contests of wrestlers and horsemen. On hearing this, a Persian asked what the prize might be for which they strove, and was told that it was an olive wreath. 'Ah, Mardonius,' exclaimed one of the satraps who were standing by, 'what men are these against whom you have brought us here to fight, who strive not for money, but for glory?'

(12) The Dream of Xerxes.

The Greeks believed that a divine purpose sent Xerxes to invade their land for his own destruction. The wisest among his counsellors did all that they could to make him give up the enterprise; but their words only roused the wrath of the king, who laid himself down on his couch in trouble and vexation of spirit. As he pondered the matter, he thought that he ought to heed the warnings of his friends; but while he slept, he fancied that there stood over him a man, fair and tall, who said: 'Dost thou repent from leading an army against Hellas, when thou hast charged thy people to gather their hosts together? There is none that will forgive thee if thou doest so.' When the day dawned, Xerxes took no heed of the dream, but calling the Persians together, told them that his counsel was changed, and gladdened them with the tidings that he did not mean to go against the Greeks. But the same vision stood over him again the next night, and said: 'So now, son of Darius, thou hast changed thy purpose in the sight of the Persians, and put aside my words as though they had never been spoken. But be sure that if thou set not out forthwith, thou shalt be made low in a little while, even as in a little while thou hast been made great and mighty.' Then the king sprang from his couch in fear, and sending for his uncle Artabanus, told him how the vision bade him do that which he felt that he ought not to do. 'If it be a god,' said Xerxes, 'who sends the vision which has threatened me, and if the Persians must go against the Greeks, then the same vision will come to thee if thou wilt take my place, and will give thee the like charge. Therefore put thou on my dress, and sit first upon my throne, and afterwards sleep upon my couch.' At first Artabanus would not do this, because he thought himself unworthy; and he said too, that the dreams which come in sleep are for the most part visions of those things on which we have thought most during the day. 'But,' he added, 'if it be not as I suppose, then let the vision which has come to thee appear to me, and give me the same charge. Yet if it must come, it ought to come to me no more if I put on thy dress than if I wear my own, and no more if I rest on thy couch, than if I lay myself on my own. For whatever it be, it is surely not so silly as to think on seeing me, that it is looking on thee. If then, refusing to come to me, it shall return to thee many times, I should say that it was sent from heaven. But if thy purpose is fixed that I must sleep on thy couch, so let it come even to me. In the meanwhile I shall remain in my present mind.' So Artabanus put on the king's robe, and sat down on his throne, and thence went to his couch; and the dream of Xerxes came and stood over him, saying: 'Art thou he that movest Xerxes from going against Hellas, as though thou carest for him? Be sure that thou shalt not go unscathed, if thou seekest to turn aside that which must be; and what Xerxes must suffer if he obey not, has been already shown to him.' Then the dream appeared as though it were about to sear out his eyes with hot irons; and Artabanus, leaping up with a cry, told Xerxes of the vision and confessed his error. 'As a man who has seen many great and mighty things yield to what is mean, I thought that if thou couldst but remain at rest, thy lot would be held blessed by all mankind. But I see that thou art seized on by a dream from heaven, and my own mind is changed within me. Charge the Persians, therefore, to do as thou didst bid them at the first.' But yet another vision came to Xerxes, who dreamed that he was crowned with an olive wreath, and from the olive sprang forth branches overshadowing all the earth, and presently the wreath that was around his head withered away. From this the magicians judged that all the earth should be subdued before him; but the dream was like the vision interpreted to Pharaoh's chief baker by Joseph in the prison (Gen. xl.).

(13) Epameinondas at Mantineia.

At the moment when the Thebans were winning a decisive victory over the Spartans on the field of Mantineia, Epameinondas was struck by a spear, the head of which broke off and remained in his breast. At once the exultation of success was exchanged for intensity of grief, as his people crowded round the dying chief, whose life, the surgeon said, must end with the drawing of the spear-head from the wound. 'You die childless,' said one of these friends, his voice choked by his tears. 'Nay,' answered Epameinondas, 'I leave two daughters, the victory of Leuktra and the victory of Mantineia.' He then asked for two of the Theban generals, and was told that they were both slain. 'Then you must make your peace with the enemy,' he said, and ordering the lance-head to be drawn from his breast, died with the calmness of a brave man who has done his duty (B.C. 362).

(14) Pope Gregory the Great and the Emperor Maurice.

With Englishmen generally the name of Pope Gregory the First, or the Great, is associated with the story which accounts for the mission of St. Augustine to this country. All know the tale which tells how Gregory in the Roman slave-market saw some beautiful fair-haired children exposed for sale; how, on hearing that they came from Britain, and that they were pagans, he expressed his sorrow that the prince of darkness should possess such lovely forms; how, on hearing that they belonged to the nation of the Angles, he said, 'Truly they are angels;' and how, on hearing further that they came from the province of Deira, and from the kingdom of Ælla, he exclaimed, 'Truly they must be rescued, *de ira*, from the wrath of God, and Alleluia must be sung in the dominions of their king.' But all do not know the life and the character of Gregory in its strength and its beauty, or again in its darker aspects. In the latter we see in him the true forerunner of one scarcely less illustrious than himself, the seventh Gregory (Hildebrand). Gregory was a monk, and the rule was that none in the house of which he was the head should have any private property. One of the brethren on his death-bed confessed to a fellow-monk that he had three pieces of gold. The coins were found hidden away with some medicine. Instantly Gregory ordered that no one should be admitted to the sick man except his brother, and his brother was to say nothing more than that he died hated by the whole society. His body was cast out upon a dunghill, and the three pieces of gold were cast after it, while the monks cried aloud, 'Thy money perish with thee.'

As Pope, Gregory was unswerving in the assertion of his authority. Maurice, the Emperor of the East, had ratified his election with manifest reluctance, had treated him coldly, if not with some contempt, and had, at the least, done nothing to prevent the Patriarch of Constantinople from calling himself Universal Bishop. Maurice was dethroned by the usurper Phocas (a man whose countenance was as horrible as his character), and took refuge in a sanctuary (A.D. 499). Phocas interfered on behalf of the Greens against the Blues, factions which sometimes desolated the city, and filled its streets with blood; and the Blues cried out that Maurice was not dead, and might live to avenge them. Phocas at once ordered the fallen sovereign with his children to be brought before him. One after another Maurice's five sons were butchered before him, and at each stroke the father, looking on without a tear, exclaimed, 'Just art Thou, O Lord, and righteous are Thy judgments.' The head of Maurice fell last; and all, by the orders of the tyrant, were left unburied.

The tidings that Maurice had fallen, and that Phocas sat in his seat, drew from Gregory hearty thanksgivings for the mercy and benignity of the new ruler. He called on heaven and earth to rejoice at the happy revolution, and expressed his assurance that the peace and prosperity of the empire would be secured by the piety of Phocas. Such was the judgment of a man of whom it has been said that 'he was blinded by one absorbing object, the interest of the Church, which to him involved the interest of religion, of mankind, and of God.'—Milman, *History of Latin Christianity*, Book III. ch. 7.

(15) The Founder of the Benedictine Order.

Of all the founders of monastic orders, Benedict of Nursia was perhaps the most illustrious. Born in the latter part of the fifth century, he was sent for his education to Rome; but the child was resolved to flee from the snares of a wicked world, and escaping from his father's house, found his way to Subiaco, whither his nurse Cyrilla followed him. From this time his life exhibited a constant succession of marvels and miracles, which seemed to leave the ordinary course of human events altogether in the background. His nurse let fall and broke a stone sieve, used in this part of Italy for baking bread. The boy held the two pieces together, and his prayer reunited them. The people hung the sieve over their church door, but Benedict shrank from their veneration, and buried himself for three years in a cave, to the mouth of which Romanus, a monk of a neighbouring monastery, let down by a rope all the food that was ever supplied to him. This cave was on the summit of a precipitous rock, at the base of which the waters of the Anio surged and roared. On the other side rose another rock not less precipitous, where his sister Scholastica found a refuge.

In this hiding-place he remained for three years, known only to Romanus. At the end of this time a neighbouring priest had prepared an Easter-day dinner for himself, after the long fast of Lent; but his heart reproached him for feasting while the servant of God was starving. Who this servant might be, he knew not; but he took up his meal and was guided miraculously to the cave of the young hermit. Benedict had lost all count of days and seasons; nor would he touch the food until he had proof that it really was Easter-day. The secret was now betrayed. The countrymen who hurried to see him, and who saw him wrapped in skins, took him for a wild beast; but his eloquence melted their hearts, and led them to reform their lives. There now followed a time of hard trial for the recluse. The image of a maiden for whom he had felt some tenderness at Rome presented itself to his mind. He rolled himself on the sharp rocks and brambles, and banished it for ever. Some monks in the neighbourhood besought him to become their abbot: he told them that they would not like his rule, but they would take no refusal. His rigid austerity soon changed their disposition towards him. They tried to poison him; but the poisoned cup burst when he took it in his hands. Benedict calmly reproved them, prayed for their forgiveness, and returned to his cave, which now became the centre of a cluster of a dozen convents, each with twelve inmates. Here he was joined by the young nobleman Maurus, afterwards known as St. Maur, who was to be his successor. A youth, named Placidus, drawing water from the lake, fell in and was carried off from the shore. Benedict called to Maurus to help him, and Maurus, walking on the water, brought him to land. The incident was a miracle; but Maurus assigned it to the holiness of Benedict, and Benedict to the devotion of Maurus. The controversy was settled by Placidus, who said that, while he was drowning, the sheepskin cloak of Benedict had hovered over him.

Benedict had long since broken up his father's household. It was his special desire that his sister should follow his example, and she did so. But he

went to see her in her solitude once a year. When he came for the last time, as she lay on her death-bed, she prayed him to remain in the convent till the next day. It was impossible, he said: it was against his rule, and he had never spent a night out of his monastery. His sister prayed earnestly, and a fierce storm of wind, lightning, and rain came on. 'The Lord have mercy on you, my sister;' cried Benedict, 'what have you done?' 'You have refused my request,' she said, 'but God has not; go now, if you can.' A few days later he saw his sister's soul soaring to heaven in the form of a dove; and in a little while he himself reached the end of his earthly pilgrimage. In his distant convent at Auxerre, Maurus saw a pathway lit with lamps, stretching from Benedict's cell to heaven. It was the road by which the soul of Benedict was journeying to Paradise.

Such was the form into which the lives of monks and saints were thrown in the times known specially as the Ages of Faith.

(16) The Mission of Mahomet.

Mahomet, it is said, received his first revelation from heaven in one of the caves with which the mountain of Hira, in the neighbourhood of Mecca, is honeycombed. The messenger who announced to him his mission as the last of the prophets was the angel Gabriel, who appeared as a being whose feet rested on the earth, while his head touched the heaven. From this time all things in heaven and earth seemed to have a voice for him. As he walked along, the stones cried out 'Prophet of God,' and when he slept the same angelic form renewed the call. For a while Mahomet feared that these visions might be only the cheats of a disordered mind, but he was encouraged by his wife Khadijah, who, expressing her conviction that virtues such as his could not be thus severely tried by the Almighty, resolved to put these apparitions to a conclusive test. When next the vision was seen, Khadijah was sitting in the presence of her husband veiled. Thus shrouded, she put her arms round Mahomet and asked him whether he saw the angel. 'I do,' was the answer. Throwing aside her veil, she asked whether he saw him still, and he said, 'I do not.' 'Then,' cried Khadijah, 'peace be to thee; it is an angel, not a demon; for a demon would not have vanished when I put aside my veil.'

After many such appearances, the angel showed himself at last so distinctly, that Mahomet, still suspecting that he might be the victim of madness, hurried away to the edge of the mountain precipice, intending to throw himself over. Seizing him under his wing, the angel bade him read. 'I cannot read,' was the answer. 'Then repeat,' and he repeated after the angel the words which imparted the revelation and the mission of Islam. Returning to his house, Mahomet, prostrate from weakness and cold, laid himself down to rest. But he was not to be thus suffered to slumber. 'Rise,' said the angel. 'Why should I rise?' asked the prophet. 'Rise to preach,' was the answer: 'cleanse thy garments and fight with the evil.' When Mahomet told his wife that he had received this divine charge, her only reply was: 'I will be the first believer.' As they knelt together in prayer, and then at the angel's bidding performed their ablutions, the child Ali, who was to live to be the fourth Caliph, and whose sons were to die martyrs on the battle-field, asked them the reason for their doing this. Mahomet told him that it was because he had been commissioned to be the prophet of God, and that for all who believed this revelation salvation was assured. Thus Ali became the second of the faithful.

This was a beginning, but the work went on with extreme slowness. Two years passed before Abubekr and Othman, the first and the third Caliphs, made the confession of their faith; and even after this, Omar, who was to be the successor of Abubekr, undertook to murder the prophet for a hundred camels and a thousand ounces of silver. 'Before thou doest this,' said a convert, 'look to the people of thine own house.' Omar rushed to the abode of his sister, who had professed her belief in the prophet; he found there some sentences of the Koran, and reading them, was converted himself. But the malice of Mahomet's enemies was in no way abated. He moved from one bed-chamber to another, to avoid the dagger of the assassin. In one instance he is said to have escaped only because Ali took his place in the tent; and once while he slept in a cave, a spider, we are told, spread its web across the entrance, and a pigeon laid two eggs to show that no one had been there to disturb her.

Thus Mahometanism has a poetry answering to the poetry which we find in the legends of the founders of Christian monastic orders.

(17) Mahomet and the Persian King.

The mission of Mahomet was to enforce the authority of a book by the sword. The true believer was a warrior whose duty it was to carry on a life-long struggle with all who would not receive Islam. Death or the Koran should be the real and only fit alternative. The unbeliever had no right to life. The faithful might of his free grace suffer him to live, if he pledged himself to pay tribute, but the promise was a surrender of all that would make life bearable. The tributary lost all title to civil rights; he could not claim the protection of law; and the judges were instructed to make his days as miserable as they could. When once the tide was turned for Mahomet, it flowed in freely and with irresistible force. The prophet who fled in fear of his life from Mecca was soon able to send a peremptory summons to the king of Persia and the Roman emperor to acknowledge his mission and to adopt his faith. The Persian king was encamped on the banks of the Karasu when he received the letter of Mahomet. He tore it up, and as the wind scattered the fragments, he said, 'So shall his empire be torn in pieces.' The stream had hitherto fertilized the whole country; but now, in horror at his impiety, it shrank its waters within limits which made them utterly useless. From the Roman emperor the prophet's letter received very different treatment. The legend tells us that he took it with the utmost reverence, and placed it on his pillow, and that only the fear of losing his crown withheld him from professing himself a true believer.

For the faithful generally, Islam had potent inducements leading them to bestir themselves under the prophet's standard. Unimaginable torments awaited the apostate after death; nymphs of surpassing loveliness were ready to welcome those who died smiting the

infidel on the battlefield. 'Fight, fight; Paradise, Paradise!' was the war-cry of Khaled, the Sword of God. 'I see,' cried another in the thick of the fight, 'I see the black-eyed girls looking upon me, for the love of one of whom, if she could be seen on earth, all mankind would die. One of them has in her hand a kerchief of green silk, and a cap gleaming with precious stones, and she beckons to me, calling out, "Come quickly, I love thee!"'

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'How I teach Arithmetic.'

(Continued from page 17.)

BY WILLIAM SPENCER,
Author of 'Spencer's Exercises in Arithmetic.'

IN working the Simple Rules, beyond giving the younger children an idea of concreteness in the most elementary stages, we have dealt chiefly, though not exclusively, with abstract numbers and mechanical operations. Few actual problems have been given, my view of the matter being, that in the Simple Rules it is preferable to secure expeditious mechanical working preparatory to the higher stages. In teaching persons who will never advance much, if at all, beyond the Simple Rules—as adults in a night school —more problems should be given; but for children, most of whom will be carried much further, problems may be deferred till Compound Rules are taken up, to which we now turn our attention. Though Compound Rules are sometimes *commenced* in the fourth class, it is in the third class that the real work of teaching them both as mechanical exercises and as problems is undertaken. With the *third* class, then, we now commence work.

The following exercises are specimens of a first lesson in Compound Addition:—

s.	*d.*		*s.*	*d.*		*s.*	*d.*
2	4		3	5		6	8
3	2		4	4		7	9
4	1		3	7		4	7
3	2		8	4		5	10
12	9		19	8		24	10

First call attention to the putting down of the first example, the first line of which is not 24 (twenty-four) as in Simple Rules, but two shillings and four pence. Show that the figures are separated by a *line*, or *dots*, or—as in printed matter—by *distance* only, and the name (or denomination) of each figure or group of figures is placed at the head of each column. Show also that the names are generally abbreviated—that £ *s. d.* are shortened forms for pounds, shillings, and pence. The origin of these letters (£ *s. d.*) had better at once be explained, otherwise the more intelligent and inquisitive children will puzzle over these cabalistic signs. As children are very apt to omit the headings in compound arithmetic generally, and thus consequently make egregious blunders, insist at the commencement on the headings being duly attended to.

In the first example above, as the pence do not amount to *ten*, we simply add up both columns as in Simple Addition. In the second example, as the pence amount to 20, explain that we do not put down 0 and carry 2, as in Simple Addition, but that we get all the shillings we can out of the pence, putting down the odd pence under the pence column, and carrying the shillings to the shillings column. Now add up the shillings—total, 19s. 8d. Proceed similarly with the third and other examples. Now advance to £ *s. d.*, first without farthings, then with them, explaining that farthings are represented as fractional parts of a penny—not as integers. Explain and impress well how 1, 2, and 3 farthings are written down as parts of a penny—$\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$; then add up several columns of them (farthings) *alone*, to familiarize the children with them, as I generally at first find more blunders here than in the other columns. In adding up the $\frac{1}{2}$d. call it *two* farthings, or the $\frac{1}{2}$ is considered as inverted ($\frac{2}{1}$), and then all the *upper* figures are simply added together. Compound Addition is easily taught, and also easily understood as to the *modus operandi*, but much practice is required to ensure even moderate accuracy. I find from experience more inadvertencies—'slips' we call them—in Compound Addition than in any other branch of arithmetic. It is highly necessary, however, that proficiency—including accuracy with rapidity—in addition should be steadily kept in view, as in after life, with the great majority of people, it is far oftener called into requisition than any other arithmetical process whatever. The importance of correct adding has long been acknowledged by the Government in its examinations for the public service, by giving special exercises in 'long addition.'

As a compound addition sum requires more time to put down on the board than almost any other kind, it often happens that children really see very few done on the board,—hence inaccurate results in their own working. *One* sum put down can easily be slightly varied by altering a few figures, or by adding to or diminishing the number of lines, so as to make any number of exercises out of it. For slate (or paper) practice I use my *Mechanical Exercises in Money*, on each card of which the first two sums are Compound Addition.

After working at Compound Addition a week or two, with an occasional exercise in Simple Rules—especially in long division—Compound Subtraction is commenced, which is easily taught and soon understood, as illustrated in working the two following examples:—

£	*s.*	*d.*		£	*s.*	*d.*
608	14	$8\frac{3}{4}$		830	0	$7\frac{1}{4}$
190	18	$9\frac{1}{2}$		485	13	$8\frac{1}{2}$
417	15	$11\frac{1}{4}$		344	6	$10\frac{3}{4}$

In working these exercises, as in all operations now, take special pains to impress the idea of concreteness—that we are really seeing what would be left were we to take the money represented by the lower line from that represented by the upper line. In the first example let them suppose that a person owed £608, 14s. $8\frac{3}{4}$d., and that he paid £190, 18s. $9\frac{1}{2}$d., and that we wish to ascertain how much he still owes. Or vary the mode of presenting the question, by supposing that a bag contains the former sum of money, and that the latter sum is taken out,—find how much is left in the bag. Here I explain the true theory of 'borrowing' or 'adding,' as it can be more easily done than it could have been in *Simple* Subtraction; and the children being more advanced in general intelligence, they can more easily

understand the principle of operation. As the $\frac{1}{2}$d. can be taken from the $\frac{3}{4}$d. without borrowing, we pass on to the pence. As we cannot take 9d. from 8d., we take a shilling from the 14s. and change it into pence (12), which with the 8d. makes 20d., then 9d. from the 20d. leaves 11d. Again, 18s. from 13s. (not from 14s.) we cannot, then we take a pound (=20s.) from the £8,—then 20 + 13 = 33s., from this 18s. is taken, leaving 15s. Now show that as there is no higher denomination than pounds, the remainder of the process is only Simple Subtraction,—merely the taking of 190 from 607. I find, however, that although the principle of subtracting may be well understood by a child, in practice he mostly increases the subtrahend by one, rather than lessening the minuend. I account for this by his having acquired the habit in working *Simple* Subtraction, and it is, I think, on the whole to be preferred; because, when the upper figure in the pence or shillings is a cipher, as in the second example, he would be more likely to make a mistake in lessening the minuend than in increasing the subtrahend. A few days' working on slates, with an occasional example done on the board, secures both quickness and more than ordinary accuracy in Compound Subtraction, the most fertile cause of error being in carrying when it is not required rather than in neglecting to carry. Compound Addition and Subtraction are now worked together from cards—*Mechanical Exercises in Money*—the first two sums on each card being in Addition and the second two in Subtraction.

The next step forward is the teaching of Reduction. Here the scholar's mental powers are more severely taxed than in any previous stage. The working of Compound Addition and Subtraction has given a boy a slight glimmer of different denominations in relational value, but he is now called upon to grapple with the subject directly and distinctively; hence the *educational* value of Reduction as a mental discipline apart from its utility. I generally contrive to give the first lessons to a class in Reduction myself,—the first exercises in it, as in every other operation, being mental only. The older manuals on arithmetic divide Reduction into *descending* and *ascending*, the former reducing to smaller denominations, and the latter—though somewhat a misnomer—to higher. The descending process being at once both easier and more in accordance with the name—Reduction—we commence with it. Procedure:—How many pence in 3s., in 8s., in 6s. 9d., in 12s. 5d., in 14s. 7d., etc.? Yes, 14s. 7d. is 175d. Now let us do it in figures, putting down 14s. 7d. Every shilling is 12d., then 14s. are 14 times 12d. = 168d.; or 12 times 14 = 168, + 7 = 175d. Or taking another view, every shilling is 12 times as many pence, hence 18s. 9d. is 12 times 18, + 9 = 225d. Hence we see that in order to bring shillings to pence, we multiply them by as many pence as make a shilling (12), and then add in, if any, the pence given along with the shillings. Further examples:—Bring 29s. 3d. to pence; 73s. 9d. to pence. Here (73 × 12) + 9 = 885d.; now bring these 885d. to farthings,—explain clearly that there will be 4 times as many farthings = 3540. Now bring these 3540 farthings back to pence, then to shillings, noticing that the result—73s. 9d.—is what we began with. Now bring (say) £3, 17s. 11d. to farthings, explaining clearly every step in the process, and writing at the end of each successive line the denomination to which it is brought. The following might be given, and mostly worked on the board, as additional examples in a first lesson:—Bring £27, 18s. 4$\frac{1}{2}$d. to farthings; £54, 19s. 10d. to halfpennies; £168, 14s. 8d. to twopences; £9837, 14s. 6d. to threepences, etc. In the last two examples, explain well and caution as to the 8d. and 6d. in reducing—that the 8d. is only *four* twopences, and the 6d. *two* threepences. A child now begins to perceive that figures represent numbers of real things, and not merely mystic hieroglyphics invented to keep boys employed at school, a character which they somewhat assumed in working Simple Rules. A second lesson in Reduction would be somewhat as follows:—Bring 379d. to shillings; 877d. to shillings; 2179d. to £ *s. d.*; 8259 farthings to £ *s. d.*; 90,183 halfpennies to £ *s. d.*; 847 threepences to £ *s. d.*; 9181 fourpences to £ *s. d.*; 236 crowns to farthings; 835$\frac{1}{2}$ crowns to halfpennies; 9183$\frac{3}{4}$ crowns to farthings, etc. We will work out this last exercise. First elicit that $\frac{3}{4}$ crown = 3s. 9d., then 9183$\frac{3}{4}$ cr. = 9183cr. 3s. 9d. What shall we find first? 'Multiply by 5,' several are ready to say. I here remark to the children that I did not ask *how* we should do it, but *what* should be done first, *i.e.* what operation we are about to perform. After eliciting that we are first to bring the crowns to shillings, then get out of them *how* this is to be done. In working any problem that requires thought and involving varied operations, I am careful first to ascertain the steps *to be taken*, and then the *modus operandi* of taking these steps. We now bring the crowns to shillings by multiplying them by 5. A thoughtless inattentive boy would very likely multiply the whole line by 5. Show the absurdity of this—that we are reducing the crowns only (at present) to shillings. Show that the 3 shillings must be added in, and then proceed very slowly to reduce the shillings to pence, and then the pence to farthings. I generally find that a few days' practice in Reduction (money) suffices to gain tolerable proficiency, consequently *formal* exercises in Reduction are soon abandoned for more general work in the Compound Rules of money, in working which the answer is often required to be given in some specific denomination—as pence, farthings, twopences, etc. The next step in advance is to Compound Multiplication, which, as shown in working Simple Multiplication, is only a kind of Addition. Work out an easy example both ways, by putting down a sum of money (say) 6 times and adding it up, then by multiplying it by 6. In working multiplication by composite numbers, care must be taken that each line of the result is clearly understood, as in the following example:—Multiply £638, 14s. 9$\frac{3}{4}$d. by 62.

£	*s.*	*d.*	
638	14	9$\frac{3}{4}$	
		10 × 6 + 2 = 62	
6387	8	1$\frac{1}{2}$	price of 10 houses.
		6	
38324	8	9	" 60 "
1277	9	7$\frac{1}{2}$	" 2 "
£39601	18	4$\frac{1}{2}$	price of 62 houses.

Here we have to multiply £638, 14s. 9$\frac{3}{4}$d. by 62, that is, we want to know how much 62 times as much money would be. We will suppose this sum to be

the price of a house; then we wish to ascertain the value of 62 similar houses. As before observed, let the children see clearly *what* we are aiming at, before we commence working. Point out the difficulty of multiplying by 62 at once; then give a notion of composite numbers by showing (say) that 30 houses would cost as much as 3 times 10 houses, 60 houses as much as 6 times 10 houses, etc. As 62 is not found as the product of any two simple numbers in the table, we take a number conveniently near to 62, as 10 times 6, and 2 more. Explain clearly the formula of expressing this as above, see that each of these signs is clearly comprehended and remembered, and insist that in working, such formula is clearly and fully put down; as children in working arithmetic at any stage are apt to put it down in a fragmentary and indistinct manner, thus making many mistakes in their work in consequence.

Having multiplied by 10, show that the result is ten times the upper line, or the price of 10 houses, and express this as above. Having multiplied this result by 6, the majority of the class will perceive this result is the price of 60 houses, but some imprecocious ones will say that it is the price of 6 houses. Now proceed carefully to get the price of the 2 remaining houses, and complete the work; show clearly what result we have obtained—that 62 houses, each worth £638, 14s. 9¾d., would in all be worth £39,601, 18s. 4½d. This answer might now be brought to farthings, halfpennies, or three-halfpences, as an exercise in Reduction. As some Inspectors give multiplication of money by thousands—(say) 6389, it is well to teach children to form composite numbers to this extent by multiples of 10 as far as the highest power of 10 given, and then to multiply each line by its specific corresponding figure. The wisdom and equity of such exercises appear doubtful, as they belong rather to 'Practice' than to Multiplication. I now give about a fortnight's working to the Compound Rules so far taught, the exercises being supplied as before from dictation, writing them on the board, or cards—doing all on the card except those in Compound Division.

The next move forward is to Compound Division, one specimen of which we will work carefully out:—

	£	*s.*	*d.*	
9)	637	14	9½	
	£70	17	2¼	—4 nuts each,—and 4 nuts over.

Explain clearly that we are here going to divide £637, 14s. 9½d. into 9 equal parts, or equally among 9 persons; and that we wish to know what each part will be, or how much each person will get. Having divided the pounds, we have £7 over, which we change for 140s.,—the children's attention being aroused by imagining that we send a boy with 7 sovereigns to exchange for 140s. Then 140 + 14 = 154s., which enables us to give 17s. to each of the 9 persons, and leave 1s. over. Then proceed similarly with the pence and farthings, leaving 5 farthings over. Still further to excite interest, I often suppose the surplus farthings to be spent in fruit, nuts, etc. Here we suppose the 5 farthings to be spent in nuts at 8 for a farthing, thus obtaining 40 nuts, which gives 4 nuts for each, and 4 nuts left over. The 4 surplus nuts, I might facetiously remark, I will pocket for doing the sum, as there is not one each for the 9 persons.

After a few days' working some scores similar to the above, Long Division of Money is taken, an example of which we need not work out at length, having gone at length into the working of an example in Simple Long Division. Here explain as before, that Long Division *records* the work more at length, and places the answer in a different relative position to the amount divided, but that the principle of working is precisely the same. The whole of the Compound Rules of Money having now been taught, copious examples are now given in all the modes previously referred to, especially daily working of *Mechanical Exercises in Money*, of which all the varieties of examples the children are supposed to be able to work.

When *mechanical* proficiency in working money is fairly secured, *problems* requiring thought and contrivance are taken pretty freely. I will go through the process of working out a card (No. 14) in *Problems in Money* as specimens:—(1) If rabbits are 1s. 3d. each, how many could be bought for £415? The question having been written plainly and fully on the board, I proceed as follows:—What do we want to know? How many rabbits for £415? One costs 1s. 3d. Then we can buy as many rabbits as there are 1s. 3d. in £415. How shall we find that out? Divide £415 by 1s. 3d. *How* can we divide it? Get them both to the same thing. What shall we get them to? Some will say farthings, others pence, and a few of the most thoughtful will say to threepences. Having worked the problem (say) by both pence and threepences with the same result (6640 rabits), lead them step by step—2 will cost 2s. 6d., 4 will cost 5s., etc.—to see that 16 rabbits will cost £1, and that the shortest method would be—16 × 415 or 415 × 16 = 6640 rabbits as before.

(2) Divide five and a quarter guineas among 21 boys. How much will each get? First elicit that 5¼ gs. = £5, 10s. 3d., by questioning out that 5 gs. = £5, 5s. and the ¼ g. = 5s. 3d.; then divide by 21 by *Short* Division. Work this question also by mental arithmetic. Elicit that if there was *one* guinea (21s.) each boy would get 1s., and as there are 5¼ gs., each will get 5¼s., or 5s. 3d.

(3) A shopkeeper burnt 63,500 cubic feet of gas in a year. How much would it come to at 3s. 9d. a *thousand* feet? Impress well that 3s. 9d. is the price of a *thousand* cubic feet—not of *one* foot. Give some notion of a cubic foot and the mode of measuring gas. A little questioning will bring out 63½ thousand feet, hence that we require 63½ times 3s. 9d.,—result, £11, 18s. 1½d.

(4) Ten pounds being divided among 50 girls and 30 boys, each girl received 2s. 3d.; find how much each boy would get. This question requires more thought than any of the three previous ones. Read it over aloud slowly two or three times. Each girl gets 2s. 3d.,—then we can find what *all* the girls get, —£5, 12s. 6d. There is £10 in all, and the girls receive £5, 12s. 6d. Who get the remainder? The boys. How many boys are there? Find the remainder—£4, 7s. 6d., which divided among 30 boys gives 2s. 11d. each.

(5) If a turkey be worth a goose and a hare, and a hare be worth 2s. 9d., and a turkey worth 10s. 6d., find the value of fifty geese. Read the question over slowly and carefully as before. Which is the most valuable? A turkey. What is it worth? 10s. 6d.

Elicit that it is worth also both a goose and a hare. Now show that we know the price of the hare,—hence 10s. 6d. – 2s. 9d. = 7s. 9d., the price of a goose; then 7s. 9d. × 50 = £19, 7s. 6d. Ans.

Compound Rules of Money, including Reduction, being the limit of arithmetic in the third class, exercises and problems in them, together with frequent exercises in high numbers in the Simple Rules, form the staple work of the class for the greater part of the year—especially for the two or three months immediately preceding the inspection, as the majority of the class will be examined in the Third Standard. In this class the examples are, as in the lower classes, supplied by original questions dictated or set on the board, or by cards. By original questions I mean those made for the occasion, not taken from any book or card; or if thus taken, then more or less altered so that the result is different. The answers to questions from books and cards should not become too familiar, otherwise the result may sometimes prove unsatisfactory, both industrially and morally. The following five sums are a fair specimen of an *early*, and therefore easy, lesson written on the board at this stage:—

(1) Take £607, 14s. 10¼d. from £4000, and bring the remainder to farthings.

(2) What would 45 horses cost at £25, 18s. 9½d. each?

(3) Bring 6189¼ guineas to threepences.

(4) If caps are 2s. 4½d. each, how many can be bought for £26, 15s. 8½d.? State clearly what money is left.

(5) Divide £8179, 16s. 8¾d. by 307.

The cards—which increase in frequency of use the higher we go in the school, as well as in proportion to greater proficiency being acquired in each class—now used are 'Mechanical Exercises in Money,' 'Problems in Money,' and occasionally a card in 'Simple Multiplication and Division.' Young teachers are in danger of thinking that mechanical work will produce the best results at an examination; but my own experience, beyond the Second Standard, is decidedly contrary to this opinion. Hence, when fair mechanical skill is acquired, a large proportion of the time devoted to arithmetic should be given to problems, as they cultivate a child's reasoning powers, and thus strengthen his mental grasp for other subjects as well as for arithmetic. Third Standard test cards are also occasionally used for their specific purpose—*tests*—not for general working.

The mental arithmetic for the third class may best be shown by a list of specimen questions:—How much is 700d., 824d., 669d., 939d.? What would 7 lb. of butter cost at 1s. 3d. a lb., 9 lb. at 1s. 4½d., 13 lb. at 1s. 2½d., 18 lb. at 1s. 1¼d., 25 lb. at 1s. 2½d., etc.? What would 2½ yards cost at 5s. 6d. a yard, 3½ at 6s. 6d., 8¼ at 2s. 6d., etc.? 40 slates at 1½d. each, 60 at 2½d., 80 at 2¼d., 100 at 3¼d., 200 at 4½d., 150 at 3½d., 240 at 5¼d., etc.?

We now pass to the teaching of the *second* class, of which a few young intelligent children may not yet have passed the Third Standard, and a few imprecocious ones, lacerated and maimed, may have just scraped through the Fourth Standard; but the majority of the class are preparing for the Fourth Standard. The first advance in teaching in this class is to Compound Rules of Weights and Measures, the pre-requisite to which is committing the tables to memory, which is often partially done in the third class. In going through the tables, care is taken that the scholars, by explanation, reference, and comparison, form some notion of what the terms used really represent. A lb., a cwt., a ton, a furlong, an acre, a gallon, etc., may be compared with some sensible objects at hand, or with something with which they are familiar.

The tables being well known and understood, the teaching of Compound Rules in them is so similar to the teaching of Compound Rules of Money, that little difficulty is met with so far as teaching is concerned—no new principle or even process being required, although, of course, much practice is required to secure expertness and accuracy. Here, also, in Weights and Measures, we have greater scope for the working of Reduction in all its conceivable phases, which alternates well with copious mechanical exercises in the four Compound Rules. When the scholars are *au fait* in the above work, 'Problems in Weights and Measures' are plentifully worked, alternating pretty often with 'Problems in Money.' I find when a boy can work these two packets of cards even fairly, assuming that he can also work the corresponding mechanical exercises, he is fairly safe for the Fourth Standard examination, as they extend somewhat beyond the requirements of the Code.

The next move forward is to take 'Simple Practice,' which requires skilful teaching, in order that each step may be duly comprehended. A few exercises may be given in illustration:—(*a*) 8175 oranges at ½d. each. Now if they were 1d. each, the amount would be 8175d.; but show they are only *half* a penny each, and work accordingly. (*b*) 7835 oranges at ¾d. each. Here, as no number of times ¾d. exactly makes a penny, explain that we see what they would be at ½d. each, and that the other farthing in value would be half the price at the ½d. (*c*) 9175 books at 8¾d. each.

6d. is ½	9175 at 8¾d.			
2d. is ⅓	4587	6	= price at 6d. each.	
½d. is ¼	1529	2	= „	2d. „
¼d. is ½	382	3½	= „	½d. „
	191	1¾	= „	¼d. „
20)	6690	1¼	= price at 8¾d. each in *s. d.*	
	£334 10	1¼.	Answer.	

Were the articles in the above example a shilling each, they would be worth 9175s., consequently at 6d. each they are worth *half* this number of shillings. We have 2¾d. in the price left, and as no number of times 2¾d. exactly make 6d. or 1s., we take as much of it as we can—2d., which is one-third of 6d.; consequently the articles at 2d. each cost one-third of the price at 6d. each as above. We might now take the remaining ¾d. as ⅛ of 6d., but for beginners it is better to take parts of the last preceding price until the process is clearly understood and some expertness in manipulation is attained. We therefore now take ½d. as ¼ of the 2d., and then the remaining ¼d. as ½ the ½d., and complete the working as above. Work others as a first lesson—(say) 7189 at 9½d., 61831 at 4¾d., 9427 at 5¼d., 4109 at 10¾d., etc.

After a few days' working at such exercises as the

above—pence only—we proceed to take shillings and pence, worked at first by multiplying by the number of shillings and taking parts for the pence as before—which, however, involves no new principle. A few early examples might be—8109 caps at 1s. 4½d. each, 7089 at 2s. 8½d.; 6109 tons of coal at 9s. 2¾d. a ton, 84,091 at 13s. 10½d., 9473⅓ at 16s. 5½d., etc. In the last exercise show that the easiest method of working the fraction (⅓) is to leave it till the last, simply adding ⅓ of 16s. 5½d. to the various amounts previously obtained. After a few lessons and a few days' practice as above, parts of a £, instead of parts of a shilling, are taken, several exercises being worked both ways showing the results to be identical. We are now prepared to work prices consisting of £, *s. d.*, as all that is required additional is to first multiply the number of articles by the number of £'s in the price, and then take parts of a £ for the shillings and pence as before. Examples:—7183 coats at £1, 16s. 8½d. each, 91835 at £3, 11s. 4¾d.; 9283 oxen at £12, 12s. 1½d. each, 7107 at £28, 14s. 7½d., etc. As the chief difficulty felt by a scholar here is in adjusting the pence, or shillings and pence, to their correct fractional parts of a shilling or pound respectively,—or some previous fractional part,—such exercises are often done on the board without working the sum fully out, *i.e.*, only arranging the fractional or aliquot parts. After some weeks' drilling in 'Simple Practice,' liberally interspersed with working *problems* in the Compound Rules, especially Weights and Measures, 'Bills of Parcels' are taken up next in preference to proceeding to 'Compound Practice.'

'Bills of Parcels' being a somewhat vague expression, I explain that the term implies statements or accounts of goods sold or bought made out *pro forma*, with a heading showing the seller and buyer, with a date or dates, and that each item of which a bill consists is to be correctly calculated, so that the total amount of the bill may be clearly seen. As 'Bills of Parcels' embody no principle or process of reckoning not previously gone over, the teaching of them is not very formidable, all that is required on the part of the worker of them being—a knowledge of the Compound Rules, Reduction, and a fair modicum of general intelligence duly applied. Readiness in mental arithmetic is here of very great service, as many of the items given may often be solved purely mentally, without any resort to pen or pencil whatever. The three desiderata in working 'Bills of Parcels' are—correctness, neatness, celerity; and these three qualities I respectively appreciate in the relative order given. Neatness and completeness should be specially cultivated here, as the quicker a boy is at figures, the more danger there is of his considering neatness as superfluous, and regarding an explicit statement of each item as a redundancy. Show clearly the nature of *settling* a bill, and why the payee's signature is required. Explain the connection between the heading of the bill and its settlement. It is amusing to notice the absurdities many children perpetrate in heading and in settling a bill, the former arising from their non-acquaintance with the proprieties and conventionalities of society, and the latter simply because the *rationale* is not comprehended. Show when a receipt stamp is required, also why not on small amounts under £2; and, if the teacher chooses, he might make a few remarks on taxation, and the necessity of it. 'Bills of Parcels,' more than any other branch of arithmetic, should be done on paper, the work which cannot be done mentally being worked on a wide margin of the same paper, or on a separate piece of scrap. As this article is occupying considerably more space than I originally intended, I shall not work out or give any examples as specimens, but at once hasten on to 'Compound Practice,' of which the following exercise will serve for reference:—Find the cost of 6 ton 16 cwt. 3 qr. 15 lb. of hay at £4, 17s. 6d. a ton.

	£	*s.*	*d.*			ton	cwt.	qr.	lb.
10 cwt. is ½	4	17	6						
			6						
	29	5	0		price of	6	0	0	0
5 „ is ½	2	8	9		„	0	10	0	0
1 „ is ⅕	1	4	4½	or $\frac{112}{224}$	„	0	5	0	0
2 qr. is ½	0	4	10½	„ $\frac{112}{224}$	„	0	1	0	0
1 „ is ½	0	2	5¼	„ $\frac{56}{224}$	„	0	0	2	0
14 lb. is ½	0	1	2⅝	„ $\frac{140}{224}$	„	0	0	1	0
1 „ is $\frac{1}{14}$	0	0	7$\frac{5}{16}$	„ $\frac{70}{224}$	„	0	0	0	14
	0	0	0$\frac{117}{224}$	„ $\frac{117}{224}$	„	0	0	0	1
Answer,	£33	7	3$\frac{159}{224}$	„ $\frac{607}{224}$	„	6	16	3	15

Here show that the price of some article—a ton in this case—is made the basis or unit of operation; not the number of articles, as in Simple Practice. The price of the 6 ton having been obtained, we proceed as above to take fractional parts of a ton for the cwts. qrs. and lbs. till the whole is taken, the process of which appears to call for no special remarks, except the mode of obtaining the exact fractions of a penny. All goes smoothly till we come to half of 2s. 5¼d., when we find we have 1s. 2d. and half of 1¼d. We might reason out the result by showing that ½ of 1d. is ½d., and ½ of ¼d. is ⅛d.; then as ½d. can be shown to be $\frac{4}{8}$d., we have in all ⅝d. Here we might leave working the sum a few minutes, and work out in the same manner several similar operations, as ⅓ of 2½ = ⅚, ⅛ of 2¼ = $\frac{9}{32}$ = ⅜, ¼ of 2½ = ⅝, etc. Now show that these little exercises can be shortly worked by putting the number to be divided over the divisor, and bringing each to the fractional parts represented by the denominator of the part of a penny. Thus $\frac{2\frac{1}{2}}{3} = \frac{5}{6}$, $\frac{2\frac{1}{2}}{4} = \frac{5}{8}$, $\frac{4\frac{1}{4}}{5} = \frac{17}{20}$, $\frac{8\frac{1}{6}}{12} = \frac{49}{72}$, $\frac{7\frac{5}{16}}{14} = \frac{117}{224}$, etc.

Going back to our exercise above, we proceed to attempt to add up the six fractions, which again introduces a new element, and requires care and close attention. Here we are really teaching addition of simple fractions, which might be done before entering on Compound Practice at all—or now taught in conjunction with it, as we have found the necessity of adding fractions to have arisen. Here explain the necessity of bringing each of the fractions of a penny to 224ths. Begin with the ½, showing clearly that it will be $\frac{112}{224}$, the ¼ will be $\frac{56}{224}$, etc. Having got the sum of the fraction—$\frac{607}{224}$, reason out that they equal 2$\frac{159}{224}$, and then complete the exercise.

Compound Practice sums are capital exercises for mechanical work, requiring also thought in taking the correct fractional parts, and care in adding up the fractional parts of a penny. When fractions, for which we are nearly ready, have been definitely taught, Compound Practice will be more easily comprehended and worked.

(*To be continued.*)

An Account of the Phonic System of teaching Reading.

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IT will not be disputed that in dealing with very young children it is advisable to adopt such methods of instruction as will tend to ease and interest the learner, and secure the best results in the smallest space of time, and nowhere are these more desirable than in the teaching of reading. The advocates of the Phonic method make claim to all these points in favour of its adoption. When perfectly carried out, it has been proved that the following standard of reading may be easily attained by a child of six years of age, of average intelligence, who has been under regular instruction the previous three years—the pronunciation good, the articulation clear and distinct, and the fluency such that narratives like those of the Gospels, or of the difficulty of *Robinson Crusoe* or the *Vicar of Wakefield*, may be read with few mistakes, and in not much longer time than the teacher herself would require.

The late Mr. W. L. Robinson of Wakefield was the inventor of this system. He began to turn his attention to the subject of infant teaching about twenty-five years ago, and for two or three years he made a great many experiments in instructing very young children himself in reading; his object being to contrive a Phonic system that should almost unite the accuracy and rapidity of the Phonetic method, and yet to use ordinary type. His first fear was that the extended alphabet of sixty-five characters, which he was obliged to compile to meet the requirements of the language, would be an insurmountable obstacle to his young pupils; but he was most agreeably surprised to find that it was easily mastered, though of course in not quite so short a time as a child would take to learn the names of the ordinary twenty-six letters; whilst the gain in reading afterwards made up ten times over for the increased difficulty of acquiring so extended an alphabet. In 1858 the managers of the Wakefield Lancasterian School, including Mr. Samuel Wilderspin, the founder of the Infant School system, having seen the remarkable results produced by the method, determined to introduce it into their infant department; and Mr. Robinson was induced to undertake to instruct the teachers, and to superintend its working in school till thoroughly established. It has now been in use over twenty-two years, and during the time several of H.M. Inspectors have borne excellent testimony to the merits of the system.

Mr. Brodie, after one of his visits, reported that 'the results of the Phonic method of teaching to read surprised me.' On another occasion he says: 'The infants are taught reading on a good method, and I can fairly say that they read exceedingly well for their age.'

Mr. Milman, after his examination of the school, reported: 'Great pains are bestowed on the reading throughout the school, and the peculiar system by which it is taught to the younger children is certainly, judging by the result, successful, inasmuch as they all, both the older and the younger, are able to read with unusual clearness, facility, and intelligence.' The following year he said: 'The first class reads remarkably well in books adapted for much older children.'

Mr. Fitch reported the first time that 'the teacher in reading achieves very remarkable results;' and the next year: 'The quality of the instruction is unusually good in all the three elementary subjects, but the special merit of the school is the reading. Every child presented in the First Standard reads with ease the lessons appropriate to the Second Standard.'

Mr. Baily reported that 'the method of teaching reading here appears to make reading much easier to young children, and deserves attention.'

Mr. Pickard, that 'the reading is unusually good.'

Mr. Legard, that 'the excellence of the reading here deserves especial mention.' And again, that 'the infants presented in the First Standard did their reading excellently.'

It may be mentioned incidentally here, that the system has been in use for three or four years in some of the schools under the Leeds School Board, and that the Sheffield and the Darlington Boards have recently introduced it into some of their schools. In Sheffield the Inspector reported after his visit to the school where the system was on its trial, that 'the methods employed are very intelligent, and have been carried out with vigour and success. The progress made in reading by such young children is remarkable.' And at Darlington, scarcely a year after its introduction, the Inspector there reported: 'The reading is in this little school taught with very great success, and in a very intelligent manner. The system seems worthy of a more extensive trial.'

Like most new proposals, the system at first had to encounter much adverse criticism. Among other objections raised against it, it was affirmed that it must lead to bad spelling. But the result has been, that while exceptionally good reading has been obtained, the spelling in the long run has gained rather than suffered by the system. This is doubtless due to the fact that the children having been taught to read so soon, a very considerable amount of time can be devoted to the transcription and dictation of many of their reading lessons, which after all has been found to be the best method of ensuring good spelling. It is pleasing to find that Mr. Blakiston, H.M. Inspector of Schools, and an experienced educationalist, in his admirable little work *The Teacher*, advocates precisely this plan of teaching spelling, and, moreover, seems to recommend a Phonic system of teaching to read. After the first year's trial, a public examination of the infants was held, when Mr. Robinson took the opportunity of explaining the system to a large gathering of the parents, many of whom were rather prejudiced against so novel a plan, and of which many of them were entirely ignorant. Children, indeed, had been withdrawn from school during the year, as they did not know their letters, and could do nothing, as one mother put it, but 'puff and blow,' alluding of course to the giving of the powers of the letters instead of their names. However, the reading of the children on this occasion thoroughly surprised those present, particularly that of a child of four and a half years, who read with ease Smith's *Baby's Debut*, and a short paragraph at sight from that day's *Times*.

The order of the ordinary alphabet is arbitrary and unphilosophical, as characters for like sounds, instead of being classed together, are separated by long intervals, as **b** from **p**, **d** from **t**, **f** from **v**, etc. The following copy of the Phonic Alphabet will show, however, that much thought and trouble must have been given to its systematic arrangement:—

p	s	th	i	ai	î
b	ċ	ṯh	y	ay	ȳ
t	ș	l	e	ā-e	ī-e
d	ẓ	r	a	ä	oi
c	sh	ẅ	o	au	oy
k	ċh	ÿ	ȯ	aw	oū
q	ŝ	x	ọọ	â	ow
g	f	x̣	ü	oa	eu
m	ph	ch	u	ō-e	ew
n	v	ġ	ē-e	oo	ū-e
n͡g	h	j	ea	û	

All the sounds in the language consist either of *whisper*, the sound of air forced through small apertures, as the **f** in **fife**, of *vocalised breath* formed by the vibration of the vocal chords while producing the whisper, or of *pure vocal tone*, as in the case of the vowels. Take from the sound **v**, as in **voice**, its *vocal element*, and the remainder is the *whisper* **f**. Add to the *whisper* **s** or **t** *vocal tone*, and the result is **z** or **d**. This is the principle upon which the whole system of consonant sounds is based.

It will be seen that the Alphabet, or the Table of the Powers of the Letters, is divided into two great divisions—*consonants* and *vowels*, the first three columns to the left being *consonant*, and the last three columns to the right, *vowel* sounds. The consonants are placed in the order of their relationship of *whispered* and *vocal* sounds; thus, taking the first column, the *whispered sound* **p**, as pronounced in the word **peep**, being followed by its *vocal power* **b**, as in **bay**; the *whispered* **t**, as in **town**, by the *vocal consonant* **d**, as in **day**; and the *whispered* **c**, **k**, **q**, as in **cat**, **king**, **quay**, by its corresponding *vocal sound* **g**, as in **gas**. These are termed explosive whispered and *explosive* vocal consonants respectively, as in producing them the breath is compressed and its egress prevented by the tongue or lips, so that on the impediment being removed a whispered or *non-continuous* noise is produced, such as is heard when a cork is drawn from a bottle. Following these are the *nasal consonant sounds* **m**, **n**, **ng**, as in **mimic**, **nun**, and **sing**, so called as the breath which produces them is entirely passed through the **nose**. Unlike those which precede them, they have no corresponding whispered sounds, the reason of which is that the whispers are either inaudible or too weak to be of any value in speech.

In the second column are arranged what are called the *continuous consonant sounds*, because it is possible to prolong them without any alteration of their character. These also follow each other in the order of their *whispered* and *vocal* representatives, as the *whisper* **s**, **c**, as pronounced in **sit** and **city**, with its *vocal* **s**, **z**, in **bids** and **buzz**; the *whisper* **sh**, **ch**, which cannot be represented except by these digraphs, as in the words **shall** and **bunch**, followed by the *vocal* **zh**, represented most frequently by **s**, as in **hosier**, and sometimes by **z**, as in the **azure**. Next follows the *whispered sound* represented by **f** and the digraph **ph**, as in **far** and **physic**, with its *vocal power* **v**, as in **vivid**. Then follows the *aspirate*, a whispered sound having no corresponding vocal element.

The third column is headed by the *whispered consonant sound* **th**, as in **thin**, followed by the *vocal* **th**, as in **then**. Afterwards follow the four *vocal consonants* **l**, **r**, **w**, **y**, as in the words **lull**, **rare**, **will**, **year**, none of them having corresponding whispered sounds. The list of consonants is then completed by what are termed the four *compound consonants*, each being composed of a combination of sounds; first, the *whisper* **x** (**ks**), as in the word **six**, with its *vocal power* **x** (**gz**), as in **exist**; and then the *whisper* **ch** (**tsh**), as in **rich**, with the *vocal sound* represented by **g** or **j** (**dzh**), as heard in the word **judge**.

In the fourth and fifth columns of the Alphabet are *seven short* and *seven corresponding long vowels*, their order being based upon the vocal organs in producing them, varying from the nearly-closed mouth in **ea**, as in the word **meat**, to the widest opening in **a**, as in **arm**; and again from the open-mouthed **au**, as in **caul**, to the nearly-closed and lip-protruding **oo**, as in **food**. The entire list is as follows, with the keyword attached to each:—

Short Vowels.

1. **i**, **y** as in **pity**.
2. **e** " **pet**.
3. **a** " **pat**.
4. **o** " **pot**.
5. **o** " **omit**.
6. **oo** " **good**. **u** " **full**.
7. **u** " **but**.

Long Vowels.

1. **e-e** as in **mete**. **ea** " **leaf**.
2. **ai** " **paid**. **ay** " **gay**. **a-e** " **sale**.
3. **a** " **arm**.
4. **au** " **haul**. **aw** " **drawl**. **a** " **call**.
5. **oa** " **boat**. **o-e** " **bone**.
6. **oo** " **moon**. **u** " **ruby**.
7. **i** " **firm**.

The Alphabet is then completed by the *four compound vowels* or diphthongs, namely:—

1. **y** as in **fly**. **i-e** " **file**.
2. **oi** " **boil**. **oy** " **boy**.
3. **ou** " **bound**. **ow** " **brow**.
4. **eu** " **feudal**. **ew** " **clew**. **u-e** " **dupe**.

The letters representing the same sound are placed within brackets in the order of usage, the first being the most frequent form of representation, and the next the less frequent, and so on. Thus the sound represented by one or other of the three letters **c**, **k**, or **q** may be said to have **c** for its *normal* letter, and not **k**, and still less **q**. In repeating the sounds the child is taught to speak of the *first*, *second*, or *third* **ké**, and so on in like manner of all the bracketed characters. The pronunciation of the vowel and consonantal letters which have more than one power is indicated by the use of various diacritical marks; as, for example, the letter **g** unmarked represents the sound heard in the word **gig**, while the **g** as sounded in **judge** is known by the dot over it. These marks are almost entirely used throughout the reading-book specially provided for the infants taught on this plan, while useless silent letters are printed in italics; thus the word 'tongues' is printed **tongu*es***. In the case of very irregular words, whose pronunciation cannot be precisely indicated either by the use of italics or marked letters, as the words **cough** and **enough**, they are at once told the child, as in the 'Look and Say' plan, for to spell them would be useless. Such words, fortunately, express such common notions, and occur so often, that they soon become impressed on the child's memory, and therefore offer little difficulty to his progress in reading.

In further continuing the subject, the value of the Phonic method may still better be shown by comparing it with other systems now in use; and in order that the differences of results may be more fairly attributed to differences of method, it must be premised that the teachers of each are equally skilful and painstaking, and that the pupils are of or about the same age and intelligence.

There are then four known methods of teaching to read; namely, the Alphabetic method, the system of Jacotot, or the Look and Say method, and the Phonetic and Phonic methods. Good reading may be taught by any one of these methods, but as they differ from each other very widely, it is a matter of importance to ascertain which of them effects its object best and in the least time.

The Alphabetic method teaches reading by spelling. The names of the letters are first learnt in their alphabetical order; then syllables of two sounds, as b-a, ba, b-e, be, b-i, bi, b-o, bo, b-u, bu, which give the long powers of the vowels united to a consonant; and a-b, ab, e-b, eb, i-b, ib, o-b, ob, u-b, ub, which give the short powers of the vowels united to a consonant; then words of more letters and sounds gradually increasing in difficulty; and lastly, easy and often very nonsensical sentences, such as, 'The hen met the big fat pig;' 'The pig met the hen;' 'The cat met the hen and the big fat pig,'—the fear appearing to exist that to give some really good reading exercises, matter would be introduced beyond the child's comprehension. Surely, if the teacher can secure from very young children distinct articulation, correct pronunciation, and other good qualities, a great deal has been done, although the sense of the passage may not be known. Words by the Alphabetic method become impressed on the memory by frequent repetition only, as the mere naming of the letters of which a word is composed seldom affords any clue to its pronunciation, and this, the oldest form of teaching reading, is the most unphilosophical of the four. Mr. Dunn, in his *Principles of Teaching*, speaking on this subject, says: 'The alphabet is usually the first subject presented to the notice of a child at school; and a more difficult or tiresome lesson he is never doomed to meet with in his whole future course. The *names* of the letters are unmeaning and arbitrary sounds. How can such an exercise be expected to produce anything but weariness and disgust?'

Again, to quote Mr. Blakiston: 'It is not easy to discover on what, if any principle the reading sheets and primers commonly used are based; but it is certain that in few schools as yet is the teaching of reading based on natural principles. Nothing but long habit could close teachers' ears to the absurdity of saying, "See oh double-you—cow," and so on. Such absurdities follow naturally from the practice of beginning by teaching children their letters, *i.e.* their *names* instead of their powers.'

Mr. Morrison, in his *Manual of School Management*, among other objections which he gives to this method, says: 'The names of the letters are seldom indicative of the sound. Thus the name sound of **h** (**aitch**) gives no indication whatever of the real sound of which the character **h** is the sign. And so in regard to all the consonants, the name of the letter or character is no index to the sound of which the letter is the sign. The name sound of **m** is **em**, but in pronouncing the word **me**, we never once think of pronouncing it as if it were **eme**. The name sound of **l** is **el**, but **leg** is never pronounced **eleg**. It happens accordingly that the child who has been taught the name sounds, finds himself utterly bewildered the moment he attempts to combine two letters into one syllable. He has been taught to call the sign **n**, **en**; but the instant the sign **n** takes an **o** after it, it undergoes a strange metamorphosis. It is no longer **en**, but something entirely and essentially different. Thus the reason of the child is outraged; he appears stupid, and the tyranny of school begins. This difficulty, more apparent in the case of the consonants, holds good even in that of the vowels. The name sound of any one of the vowels is not the sound which will meet the child in one case out of ten. Thus the name sound of **a** will guide the child to its correct sound in all those words in which the name sound occurs; but no sooner has such a word as **fat** made its appearance than the name sound becomes valueless as an exponent of the real sound of the mark **a** in the word **fat**. The name sounds are thus no true guides to the real sounds represented by the letters of the alphabet. We are not giving the child the means of interpreting the signs of sounds: we are causing him simply to repeat sounds with which he is perfectly familiar, and we are accustoming him to associate with these sounds certain characters which, when he comes to read, he will seldom, if ever, find associated with the same sounds.'

In the Look and Say method the pupil is instructed in reading words at sight without reference to the letters of which they are composed. It has been proved that those who cannot read may be taught to read without the medium of the alphabet, without syllabling words, and without spelling. The teacher places the lesson before the pupil, reads it slowly, and explains and illustrates it so as to interest the pupil. He then reads it again, the pupil saying the word after him. The teacher then reads entire sentences, after which the pupil is to repeat the

sentence, and so on by frequent repetition, until the lesson is perfectly learned. The words of frequent occurrence are soon recollected, and gradually less frequent words. The results of this method are entirely due to the memory alone, but doubtless reading is acquired by it sooner than by the Alphabetic method, inasmuch as it saves the time which has been shown to be wasted in learning the alphabet and the spelling of the words by the names of the letters. In the most irregular words of the language, it is impossible to give the instruction in any other way than by this method.

The Phonetic method provides a special alphabet of about six-and-thirty letters, one for each sound in the alphabet. A letter never represents any other sound than its own, and that sound is never represented by any other letter, and no double letters are allowed to stand for a simple sound. The simplicity and philosophical truth of the Phonetic method must lead to the acquirement of reading with more ease than by any other method whatever; and were all books written in Phonetic characters, there could be no doubt about this being the best method. But children must be able to read ordinary books; and the Phonetic plan has this disadvantage, that the pupil having learned to read Phonetic books, must undergo a process of transitional training from them to our ordinary literature.

The Phonic method in use here, as already shown in the explanation of the Alphabet, employs the *powers* or *sounds* of the letters in building up words and in reading them. By means of the marked letters, digraphs, and the printing of silent letters in italics, Mr. Robinson has rendered about three-fourths of the words in the language suitable for Phonic teaching. So that the system possesses almost the same simplicity as the Phonetic plan, but with the advantage of using ordinary type. When therefore the Alphabet or Table of Sounds has been thoroughly well learnt (and, as before intimated, this is comparatively soon done, and with little effort), the child by means of spelling arrives at once, without aid from the teacher, at the correct pronunciation of the word. The system is at once easy and pleasant to the child, and has none of the drudgery and wearisomeness to the teacher peculiar to some of the other methods. Moreover, the child is led to read with much greater distinctness and loudness than is usually the case, features which are found to be characteristic of the reading of the child throughout the whole of his future school course.

Before concluding with an account of the mode of proceeding with the teaching of Phonic reading in this infant school, it may be stated that the managers are still so convinced of the advantages of the method, that although having no interest in it beyond what it can do to aid the child in its learning, they are prepared to provide gratuitous instruction in the system to any teacher who may be desirous of giving it a trial.

This school has an average attendance of 132 children, and is taught by a staff of five teachers, including the mistress, three pupil teachers, and a monitor. The appliances used for carrying out the system are—a large Phonic alphabet 5½ feet deep by 4 feet wide, with letters 2¼ inches deep, for the purpose of collective teaching: the letters being so large, are distinctly seen by the children from all parts of the gallery, where they are seated for the lesson; four alphabets on much smaller-sized cards for class teaching; two sets of Phonic vocabulary lesson sheets, containing a large collection of regular words of from one to four syllables, the set comprising 15 sheets in all; a few reading sheets with the marks of the system, to accustom the children to read in a straight line, to become acquainted with capital letters and with irregular words; fifty of the Phonic reading-books, as well as the same number of some other unmarked book, which the children use occasionally just before they are drafted into the upper schools.

Every morning a lesson is given on the Phonic alphabet by one of the teachers to all the children together. They first go through the sounds with the teacher, then by themselves, and afterwards individual children are called upon to repeat them. After all the sounds have been repeated in this way, the teacher pays special attention to a few of them, taking a few more for special notice in each succeeding lesson until the whole are well known. Strict attention is paid to the form of the mouth in making the sounds, and by this means the children are taught to articulate sounds which they are apt to give imperfectly. Spelling is always combined with this lesson, which may be given in several forms. Either the teacher points out certain sounds on the board, the children repeating them and then giving the word spelt; or without pointing to the letters, the teacher repeats the sounds, when the children follow with the word; or again, the teacher may give the word, and the children afterwards give the sounds composing it. A little silent spelling is sometimes given as an interesting variation of the lesson for the more advanced children. The teacher chooses a word in which the sounds may be recognised by the form of the mouth. She spells it without making the slightest sound, and the children having followed closely with the eye the teacher's mouth, give the word as soon as she has finished. In the class lessons the different stages taken are lessons on the alphabet, combination of sounds into easy words, the spelling of words from the Phonic vocabulary sheets in the order of their difficulty, and reading from the marked sheets as a preparation for the Phonic reading-book. After the children are put to reading this book, the lessons on the *vocabulary sheets* are still continued, the sheets being used occasionally instead of the books. It is found that this practice enables the children to combine the sounds so readily, that before leaving the infant school they are able to read the Phonic reading-book quite fluently, although in point of difficulty it will compare with most Fourth Standard reading-books.

—o—

Recent Inspection Questions.

[*The Editor respectfully solicits contributions to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Physical Geography.

STAGE I.

(1) What is evaporation? On what does its amount depend?

(2) Tell the limits of the Tay and Esk basin.

(3) What is evaporation? How is it produced?

(4) What is a fog? What is the difference between a cloud and a fog? What kind of night does it need to produce fogs?

(5) What are the limits of the Tay and Esk basin? What counties do they flow through? also what subordinate rivers does it include?

(6) Pure air consists of two gases mixed together. Of what else does it consist? Take 100 lbs. air; how much is oxygen?

STAGE II.

(1) When are tides highest—(1) at the poles; (2) at the Equator? Give reasons for your answer.

(2) Draw out a table showing the length, breadth, and depth of the five great oceans.

(3) What are the ingredients of salt in the ocean? How much per cent. are there of these ingredients?

(4) Where does the Arctic current start from, and how does it affect the climate of Central America?

(5) How can we tell the depth of the ocean by the coast?

(6) What is a tide bore? Where do tides originate, and what are they?

STAGE III.

(1) Why is daylight longer in summer than in winter?

(2) What causes the total eclipse of the sun?

(3) What is the earth? Give the polar and equatorial diameters.

(4) How do you account for the different shapes which the moon has between new and full?

Arithmetic.

STANDARD I.

(1) Add together:—Three hundred and ninety-two, four hundred and nine, eight hundred and sixteen, nine hundred and five. Ans. 2522.

(2) Add together:—Twenty-seven, nine hundred and fourteen, thirty-two, five hundred and nine, sixty-two. Ans. 1544.

(3) Add together:—Eight, ten, four hundred and ninety-two, seventeen, six, twenty-three. Ans. 546.

(4) Subtract:—One hundred and fifty-nine from four hundred and ninety-two. Ans. 333.

STANDARD II.

(1) From forty thousand two hundred and ninety-three take fourteen thousand one hundred and fifty-six. Ans. 26,147.

(2) Take one thousand four hundred and forty-two from thirty thousand nine hundred and forty-one. Ans. 29,499.

(3) Multiply forty-nine thousand six hundred and ninety-three by four hundred and eight. Ans. 20,274,744.

(4) Multiply seventy-nine thousand eight hundred and thirty-seven by thirty-nine. Ans. 3,113,643.

(5) Divide fifty thousand and ninety-two by nine. Ans. 5565 + 7.

STANDARD III.

(1) Add together seventy-six shillings, ninety-eight sixpences, two hundred and twenty-seven pence, and four hundred and thirty-eight farthings. Ans. £7, 13s. 0½d.

(2) Find the difference between seventy-eight pounds sixteen shillings and sixpence and five hundred pounds. Ans. £421, 3s. 6d.

(3) From eight hundred and ninety-six pounds sixteen shillings and eightpence farthing take five hundred and seventy-nine pounds nineteen shillings and sixpence farthing. Ans. £316, 17s. 2d.

(4) What change ought I to receive from a ten-pound note after paying two bills, one seven pounds and a penny halfpenny, and the other one pound six shillings and elevenpence? Ans. £1, 12s. 11½d.

(5) Find how much greater the sum of one thousand and twenty pounds five shillings and two-pence is than eight hundred and seventy-six pounds thirteen shillings and ninepence farthing. Ans. £143, 11s. 4¾d.

(6) Subtract seven thousand three hundred and ninety-seven pounds seventeen shillings and eight-pence halfpenny from ten thousand and sixty pounds eight shillings and sevenpence. Ans. £2662, 10s. 10½d.

STANDARD IV.

(1) Divide three thousand eight hundred and fifty-six pounds thirteen shillings and sevenpence by nine. Ans. £428, 10s. 4⅔d. + 1.

(2) Reduce twenty-seven cub. yds. twelve ft. six inches to cubic inches. Ans. 1,280,454.

(3) Find the value of a cwt. of tea at three shillings and fourpence per lb. Ans. £18, 13s. 4d.

(4) Find a man's wages for a year at seventeen shillings and sixpence per week. Ans. £45, 10s. 0d.

(5) Reduce sixteen tons three qrs. seventeen lbs. to lbs. Ans. 35,941 lbs.

(6) How many galls. of ale or beer are there in twenty-seven thousand and fifty-three pints? Ans. 3381 galls. 2 qrs. 1 pt.

STANDARD V.

(1) Three hundred and ninety at five pounds nine shillings and fourpence halfpenny each. Ans. £2132, 16s. 3d.

(2) Eight cwt. two qrs. twelve lbs. at two pounds twelve shillings per cwt. Ans. £22, 7s. 6¾d.

(3) One thousand nine hundred and thirteen articles at two pounds sixteen shillings and tenpence halfpenny. Ans. £5440, 1s. 10½d.

(4) Four tons seventeen cwt. two qrs. at two thousand four hundred pounds per ton. Ans. £11,700.

(5) One thousand two hundred and ninety-six articles at sixteen shillings and tenpence halfpenny each. Ans. £1093, 10s.

(6)

	£	s.	d.
25 lbs. sugar at 6½d. per lb.,	0	13	6½
3 chests each 112 lbs. at 1½d. per lb.,	2	2	0
4 lbs. coffee at 1s. 1d. per lb.,	0	4	4
Ans.	£2	19	10½

STANDARD VI.

(1) If forty-six horses eat fifty qrs. of oats in sixty-four days, how many days would it take seventy-five horses to eat one hundred and twenty qrs.? Ans. 94 days 5 hrs. (nearly).

(2) Reduce ·0064 to a vulgar fraction, and express $\frac{7}{125}$ as a decimal. Ans. $\frac{4}{625}$ and ·056.

(3) Take 340·567 from 704·056, and divide the answer by ·25. Ans. 1453·956.

(4) Divide £1, 10s. 6d. by $5\frac{2}{3}$. Ans. 5s. 4½d. + 6.

(5) If seven tons of coal would supply three fires for nine months, how long will twelve tons supply five fires? Ans. 9 months 1 week 0 days 4 hrs. + 28.

(6) If 125 cost £39·51, what will 6·8 cost? Ans. £2, 2s. 11¾d.

Grammar.

STANDARD IV.

Parse—(*a*) She led him gently away from their mother's gaze.

(*b*) The nightingale is a very plain bird which has nothing in its appearance to attract us.

(*c*) The people living in these very cold regions have a carriage called a sledge for travelling about from place to place.

STANDARD V.

Analyze the following passages, and parse fully the words in italics:—

(*a*) With fire and *sword* the country *round* was wasted *far* and wide.

(*b*) Lapland *being very cold*, its waters are frozen *over* a great *part* of the year.

(*c*) *Really it* is *very wrong* of you *to grieve over* your misfortunes.

STANDARD VI.

Parse and analyze:—

(*a*) When the cat is away the mice play.

(*b*) With his spade across his shoulder to the field the workman goes.

Write a short account of the seasons.

—o—

Matriculation Chemistry.

BY E. W. V. VOLCKXSOM,

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PRELIMINARY NOTIONS.

ELEMENTS, CHEMICAL COMBINATIONS, LAWS OF COMBINATION.

ACIDS, BASES, AND SALTS. SYMBOLS AND NOMENCLATURE.

1.* What is the **object** of the science of Chemistry?

Chemistry has for its **object** the investigation of the *composition* of different kinds of matter, and the *changes* in the composition which result from the action of one kind of matter upon another, or of external forces upon matter.

2.* In what does Chemistry differ from the science of **Natural Philosophy?**

It differs in this, that **Natural Philosophy** investigates the *properties* of all bodies, and the *changes* these bodies undergo, except changes of composition.

* The numbers to which asterisks are attached indicate questions not yet asked in the London University papers, but inserted here in order to supply a somewhat complete chemical course.

3.* By what **processes** does Chemistry attain its object?

By the processes of **analysis** and **synthesis.**

4.* In what does the process of **analysis** consist?

It consists in **resolving** compound bodies into more simple bodies.

5.* In what does the process of **synthesis** consist?

It consists in **building up** a compound body from more simple bodies.

6.* By what **name** are those bodies called that have hitherto resisted *analysis* or *decomposition* into more simple bodies?

They are called **elements.** The number of clearly defined elements is about sixty-five.

7. Why do you call oxygen, hydrogen, and carbon, **chemical elements?** *June*, 1871.

Because these bodies have **not been decomposed** into two or more other bodies.

8. Explain why **oxygen, hydrogen, nitrogen,** and **carbon** are considered to be *elements.* Describe one experiment by which you could prove that **diamond** and **graphite** consist of the same element. *Jan.* 1867.

These bodies are considered to be *elements*, because, in the present state of science, they cannot be decomposed into two or more substances.

Diamond and **graphite** consist exclusively of the element carbon, because, if each substance be completely burned in oxygen, the result is the same, namely, the production of **carbonic acid,** as may be proved by passing the gas into lime-water, when a white precipitate is produced in each case.

9. Why are **oxygen** and **mercury** considered to be chemical elements? *June*, 1879.

Because they are not known to contain any other elements but oxygen and mercury respectively, or because the actual state of science has not enabled any one to decompose them into two or more elements.

10. What are the principal distinctions between **metallic** and **non-metallic** elements? *July*, 1844.

The elements have been divided for convenience into two classes, namely, the metallic and the non-metallic elements. This division is not rigorous, for the two classes run into each other. The

principal distinctions may be thus noted: the **non-metallic elements** are electro-negative, have no metallic lustre, have a low specific gravity, and are bad conductors of heat and electricity; the **metallic elements** are electro-positive, have métallic lustre and a high specific gravity, and are good conductors of heat and electricity.

11. Define the expressions **chemical affinity** and **cohesion**. *July*, 1857.

Chemical affinity is the force which causes different kinds of matter to combine, that is to say, to form compounds differing in their properties from the original substances. The act of union is called **chemical combination**, and the body resulting from this union is called a **chemical compound**. This force acts between atoms, or the smallest conceivable particles. **Cohesion** is the force which causes the various parts of a body to adhere together, so as to resist separation. This force acts between larger masses of matter than *atoms*.

12.* What is a **mixture**?

A **mixture** is the mechanical union of two or more bodies in no one definite proportion, each body, moreover, being present with its own composition and properties, without having undergone any change.

13. Two powders are given you: one is a mechanical **mixture**, the other a **chemical combination**, of sulphur and iron. In what respects would the powders differ, and by what chemical reactions could you distinguish the one from the other? *Jan.* 1876.

A given powder is composed of 32 gr. of sulphur and 50 gr. of iron. How would you ascertain whether the powder is a mechanical **mixture** or a **chemical combination** of the two elements? *June*, 1878.

The two powders would differ in their physical appearance. The mechanical **mixture** would be easily pulverized, and would be of a greyish appearance. The **chemical combination** would be hard, and of a blackish colour. The two powders would also differ in their chemical properties.

To ascertain which is the mixture and which the combination, I would first reduce both to powder, and hold a magnet near each. In one the free iron would at once be attracted by the magnet, whereas the combined iron in the other could not be attracted.

Also, I would pour on the two powders some diluted hydric chloride. In the case of the **mixture**, hydrogen would be generated, whilst in that of the **chemical combination**, hydric sulphide would be given off.

Again, the powders may be stirred up in water. After a part has been allowed to settle, the liquid should be poured off and allowed to settle again. In the **mixture** the first sediment is chiefly iron, the second sulphur; in the **compound** there is no difference in the nature of the sediment.

Carbonic disulphide dissolves sulphur from the **mixture**, but not from the **compound**.

Under the microscope, particles of iron and sulphur are distinguished in the **mixture**, but not in the **compound**.

14. A gas is found by analysis to consist of equal volumes of chlorine and hydrogen. Describe fully how you find by experiment whether the gas is a mechanical **mixture** or a **chemical combination** of the two elements. *Jan.* 1875.

I would find it out by the following experiments:—

(1.) If the gas fumes when exposed to the air, the two elements are chemically **combined**.

(2.) If a greenness is still discernible, then the gases are **not combined**.

(3.) If a light be applied to the jar containing the gases, or the jar be exposed to the direct rays of the sun, and an explosion ensues, then the two gases were present merely as a **mixture**.

(4.) If, when a rod dipped in ammonia is applied to the opening of the jar, white fumes begin to form, the two gases are in **chemical combination**.

15. Explain what is meant by a **double decomposition**, taking the decompositions which occur on mixing solutions of sulphate of soda and nitrate of barytes, or any other instance in illustration. *July*, 1846.

By **double decomposition** is meant the fact that both bodies decompose, the acid of the one combining with the base of the other. Thus, for instance, mix a solution of sodic sulphate with baric nitrate. A white precipitate of *baric sulphate* is formed, which in a short time settles at the bottom of the vessel, sodic nitrate remaining dissolved.

$$\underset{\text{Sodic sulphate.}}{Na_2SO_4} + \underset{\text{Baric nitrate.}}{BaN_2O_6} = \underset{\text{Baric sulphate.}}{BaSO_4} + \underset{\text{Sodic nitrate.}}{2NaNO_3}.$$

16.* Explain in a few words in what the **atomic theory** consists.

It consists in the *conjecture* that all bodies are composed of a finite but very great number of invisible and indivisible particles (*atoms*); that for each kind of element these particles are identical in shape, size, and weight, but differ in different kinds of bodies. The actual shape, size, and weight of one of these particles are unknown, but the relative weight of the particles of different bodies is known, and this constitutes the *relative weight* or *atomic weight* of the bodies. This theory was devised and framed by Dalton, in order to explain *the laws of chemical combination*.

17.* Define an **atom** and a **molecule**.

An **atom** is the smallest quantity of an element capable of existing in combination.

A **molecule** is the smallest quantity of a substance capable of existing in a free state.

18. What is meant by combination in **definite** and **multiple proportions**? *July*, 1845.

The law of **definite** or of **constant proportions** may be thus expressed:—

The same substance always consists of the same elements united in the same proportions.

Thus, for example, water is composed of hydrogen and oxygen in the proportion of two atoms of hydrogen to one of oxygen. This by weight makes 2 grammes or grains, etc., of hydrogen to 16 grammes or grains, etc., of oxygen, making 18 grammes or grains, etc., of water; and these elements are found in water invariably in the same identical proportions and in no other. Again, common salt always contains 35·5 parts by weight of chlorine to 23 parts by weight of sodium; and vermilion contains 32 parts by weight of sulphur to 200 of mercury.

19. Illustrate the law of **multiple proportions** by a series of examples, including compounds of carbon with oxygen, carbon with hydrogen, sulphur with oxygen, nitrogen with oxygen. *June*, 1865.

State the doctrine of **multiple proportions**, and explain it by examples. *July*, 1844.

A body capable of combining with another in several proportions, those several proportions bear a simple relation to each other.

(1.) Thus, take for example the compounds of **carbon** with **oxygen**:—

Carbonic oxide,

CO . . 12 of C with 16×1 of O.

Carbonic dioxide,

CO_2 . . 12 of C with 16×2 of O, or 32 of O.

Thus the oxygen in the CO and CO_2 stand to one another as 1 : 2.

(2.) The compounds of **carbon** with **hydrogen**, limiting them to two:—

Light carburetted hydrogen,

CH_4 . . 4 of H with 12 × 1 of C.

Heavy carburetted hydrogen,

C_2H_4 . . 4 of H with 12 × 2, or 24 of C.

Thus the carbon in the CH_4 and C_2H_4 stand to one another as 1 : 2.

(3.) The compounds of **sulphur** with **oxygen**:—

Sulphurous dioxide,

SO_2 . . 32 of S with 16 × 2, or 32 of O.

Sulphuric trioxide,

SO_3 . . 32 of S with 16 × 3, or 48 of O.

Thus the oxygen in SO_2 and SO_3 stand to one another as 2 : 3.

(4.) The compounds of **nitrogen** with **oxygen**:—

Nitrous oxide,

N_2O . . 28 of N with 16 × 1 of O.

Nitric oxide,

N_2O_2 . . 28 of N with 16 × 2, or 32 of O.

Nitric trioxide,

N_2O_3 . . 28 of N with 16 × 3, or 48 of O.

Nitric tetroxide,

N_2O_4 . . 28 of N with 16 × 4, or 64 of O.

Nitric pentoxide,

N_2O_5 . . 28 of N with 16×5, or 80 of O.

Thus the oxygen of N_2O, N_2O_2, N_2O_3, N_2O_4, N_2O_5, stand to each other as 1 : 2 : 3 : 4 : 5.

20. Explain the laws of combination in **equivalent** and **multiple proportions**. *July*, 1855.

The law of **multiple proportions** has been expressed and explained in the previous number.

The law of **equivalent proportions** may be expressed thus:—

If two bodies combine with a third, the proportions in which they combine with that third body are multiples of the proportions in which they may combine with each other.

That is to say, supposing a certain weight of a body A combine with a certain weight of the bodies B, C, D; then if B, C, D unite with each other, they will do so in the same proportion by weight as that in which they combine with A, or in some multiple of that proportion.

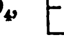
Thus 1 part of hydrogen combines with 32 of sulphur and with 16 of oxygen: therefore, when sulphur and oxygen combine, it will be in the proportion of 32 : 16, or in some multiple of those numbers.

21.* Express the law of **molecular weights**, and give an example.

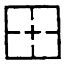
The combining weight of a compound is the sum of the combining weights of the components.

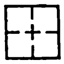
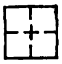
Thus the combining weight of hydric chloride is 36·5, which is the sum of the combining weight of hydrogen 1, and that of chlorine 35·5.

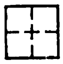
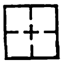
22. Explain what is understood by the **theory of volumes**. *Jan.* 1860.

A molecule of any substance, in the state of gas or vapour, occupies the same volume as a molecule, or two atoms, of hydrogen does. This is generally expressed by saying that *the molecular volume of a gas is 2 vols., or* 

The chief exceptions are—

N_2O_2, ; N_2O_4,  to ;

Cl_2O_4, ; PCl_5, ;

H_2SO_4, ; NH_4Cl, .

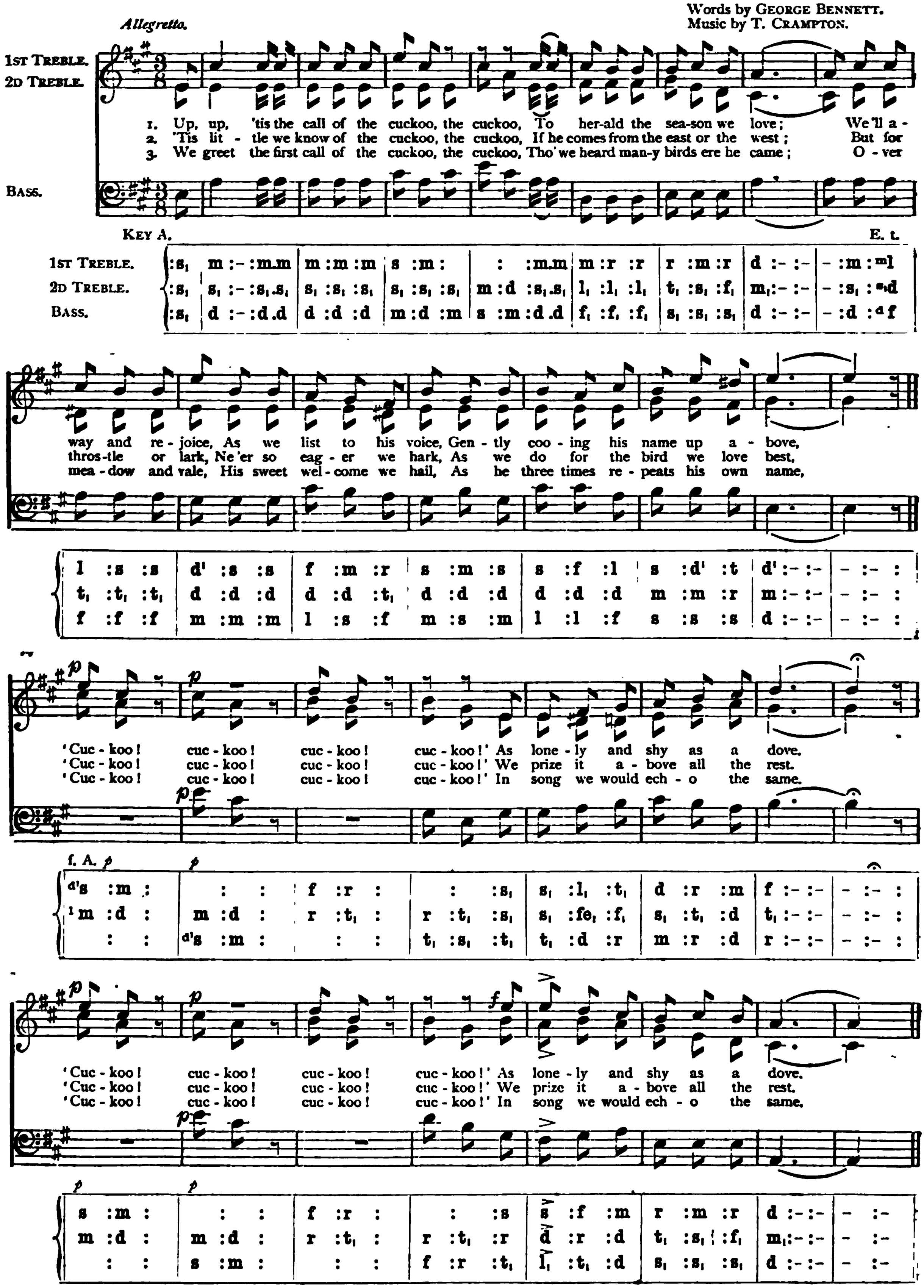
23. What is meant by the expression **atomic weight**? *July*, 1856.

The **atomic weights** of the **elements** are the *relative* weights in which the elements combine with one another, whether according to those actual proportions, or multiples of those proportions. The atomic weights are generally referred to hydrogen, which as *the standard* is assumed to have the atomic weight of 1. The numbers may stand for grammes or grains, or any other actual weight, as circumstances require.

(*To be continued.*)

THE CUCKOO'S CALL.

Words by GEORGE BENNETT.
Music by T. CRAMPTON.



'Beautiful Spring,' the song which appeared in No. 1, can be had separately at 6d. per dozen, post free.

Pupil Teacher's Examination Questions.

FEBRUARY 1881.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What should be given for 5 cwt. 3 qrs. 10½ lbs. of tea, when 59½ lbs. are worth £10, 8s. 3d.?
2. Ascertain by practice the value of 2897 articles, at £2, 12s. 9¼d. each.
3. Find the cost of draining a field of 58 acres 2 roods when a field of 2 roods 24 poles cost £3, 3s. 6d.
4. What is the dividend on £4975 at 3s. 4½d. in the £? and what is the cost of 5783 articles at £14, 9s. 6¼d. each? Add the two sums together.
5. Find the value of a piece of mahogany 18 feet long, 1 ft. 9 inches deep, and 1 ft. 4 inches wide, at 2s. 9½d. per cubic foot.

FEMALES.

1. Make out a bill for the following:—

				s.	d.	
15 gross	of	penholders	at	0	9½	per dozen.
45 doz.	,,	inkstands	,,	3	6	each.
75 reams	,,	blotting paper	,,	0	10	per quire.
510 ,,	,,	scribbling	,,	0	9	,,
60 gross	,,	pencils	,,	1	1½	per doz.
90 doz.	,,	pen-knives	,,	1	4½	each.

2. Find the cost of 613882 articles at £17, 3s. 1½d. each.
3. Find the value of 1492¾ cwt. at £15, 18s. 6d. per cwt.
4. What will be the price of 189 yds. 0 ft. 11 in. of silk at 5s. 3½d. per yard?

Grammar.

1. Point out and parse all verbs and adjectives in the following:—

> "'Tis sweet to hear the sheep-dog's honest bark
> Bay deep-mouthed welcome as we near our home;
> 'Tis sweet to know there is an eye will mark
> Our coming, and look brighter when we come.'
> BYRON.

2. The imperative mood can only be used, strictly speaking, in the second person. Why is this? How is an imperative expressed with the first and third person?
3. When is the plural of nouns formed by simply adding *s*? In what cases must *es* be added? Give examples.

Geography.

1. Mention the different names applied to *inlets* and narrow passages of water on the coast of Great Britain, and give an example of the use of each of them.
2. In what parts of Ireland are the counties of Mayo, Donegal, and Wicklow? Say what you know about each of them.
3. Explain the following statement, and show that it is true:—

'*There is a striking difference between the mountains of the Pennine Chain and those of the Cumbrian Group in almost every respect—in their general appearance, in the character of their scenery, the number and size of their lakes and rivers, besides the great difference which is expressed by the words Chain and Group.*'

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

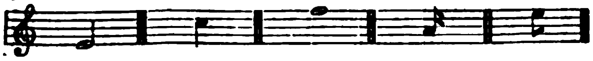
Write, in large hand, as a specimen of copy-setting, the word *Sheriffdom.*

Write, in small hand, as a specimen of copy-setting, '*If son to Talbot, die at Talbot's foot.*'

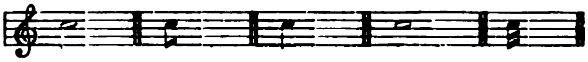
Music.

A quarter of an hour allowed for this paper.

1. Write over each of the following notes its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other):—



2. Follow each of these notes by its corresponding rest:—



3. How many tones and semitones are found in a major scale, and what are the places of the latter?

ANSWERS.—CANDIDATES.

Arithmetic.

MALES.

1. 59½ lbs. : 5 cwt. 3 qrs. 10½ lbs. :: £10, 8s. 3d., or 119 half lbs. : 1309 half lbs. :: 2499d.

$$\frac{\overset{11}{\cancel{1309}} \times 2499d.}{\cancel{119}} = 27489d. = £114, 10s. 9d. \text{ Ans.}$$

2.

	£	s.	d.	
	2897	0	0	
			2	
	5794	0	0	=value of 2897 at £2.
10s. = ½ of £1	1448	10	0	= ,, 10s.
2s. 6d. = ¼ of 10s.	362	2	6	= ,, 2s. 6d.
3d. = $\frac{1}{10}$ of 2s. 6d.	36	4	3	= ,, 3d.
¼d. = $\frac{1}{12}$ of 3d.	3	0	4¼	= ,, ¼d.
	£7643	17	1¼	=value of 2897 at £2, 12s. 9¼d.

3. 2 ro. 24 po. : 58 ac. 2 ro. :: £3, 3s. 6d., or 104 po. : 9360 po. :: 762d.

$$\frac{9360 \times 762d.}{104} = 68580d. = £285, 15s. \text{ Ans.}$$

4. (1)

	£	s.	d.	
	4975	0	0	
3s. 4d. = $\frac{1}{6}$ of £1	829	3	4	=dividend on £4975 at 3s. 4d.
½d. = $\frac{1}{80}$ of 3s. 4d.	10	7	3½	= ,, ,, ½d.
£	839	10	7½	=dividend on £4975 at 3s. 4½d.

(2)

	£	s.	d.	
	5783	0	0	
			14	
	23132	0	0	
	5783	0	0	
	80962	0	0	=cost at £14.
5s. = ¼ of £1	1445	15	0	= ,, 5s.
4s. = ⅕ of £1	1156	12	0	= ,, 4s.
6d. = ⅛ of 4s.	144	11	6	= ,, 6d.
¼d. = $\frac{1}{24}$ of 6d.	12	0	11¼	= ,, ¼d.
	83720	19	5¼	=cost at £14, 9s. 6¼d.
	839	10	7½	
£	84560	10	1	=two sums added together.

5. 18 ft. × 1 ft. 9 in. × 1 ft. 4 in.
= 216 in. × 21 × 16
= 72576 cubic in.
= 42 cubic ft.,

and 42 ft. at 2s. 9½d. per ft. = £5, 17s. 3d. Ans.

FEMALES.

1.

	s.	d.			£	s.	d.
15 gross at	0	9½	per doz.	=	7	2	6
45 doz. at	3	6	each	=	94	10	0
75 reams at	0	10	per quire	=	62	10	0
510 reams at	0	9	,,	=	382	10	0
60 gross at	1	1½	per doz.	=	40	10	0
90 doz. at	1	4½	each	=	74	5	0
			Total	=	£661	7	6

2.

	£	s.	d.	
	613882	0	0	
			17	
	4297174	0	0	
	613882	0	0	
	10435994	0	0	=cost at £17.
2s. = $\frac{1}{10}$ of £1	61388	4	0	= ,, 2s.
1s. = $\frac{1}{2}$ of 2s.	30694	2	0	= ,, 1s.
1½d. = $\frac{1}{8}$ of 1s.	3836	15	3	= ,, 1½d.
£	10531913	1	3	=cost at £17, 3s. 1½d.

3.

	£	s.	d.	
	1492	0	0	
			15	
	7460	0	0	
	1492	0	0	
	22380	0	0	=value at £15 each.
10s. = $\frac{1}{2}$ of £1	746	0	0	= ,, 10s. ,,
5s. = $\frac{1}{2}$ of 10s.	373	0	0	= ,, 5s. ,,
2s. 6d. = $\frac{1}{2}$ of 5s.	186	10	0	= ,, 2s. 6d. each.
1s. = $\frac{1}{5}$ of 5s.	74	12	0	= ,, 1s. ,,
$\frac{7}{8}$ of £15, 18s. 6d.	13	18	8¼	= value of $\frac{7}{8}$ cwt.
£	23774	0	8¼	=value of 1492$\frac{7}{8}$ at £15, 18s. 6d.

4.

	£	s.	d.	
	0	5	3¼ × 9	
			10	
	2	12	8½ × 8	
			10	
	26	7	1	
	2	7	5¼	
	21	1	8	
	49	16	2¼	=value of 189 yds. at 5s. 3¼d.
9 in. = $\frac{1}{4}$ of 1 yd.		1	3$\frac{3}{4}$ $\frac{1}{4}$	= ,, 9 in. ,,
1 in. = $\frac{1}{9}$ of 9 in.			1$\frac{3}{4}$ $\frac{1}{36}$	= ,, 1 in. ,,
1 in. = $\frac{1}{9}$ of 9 in.			1$\frac{3}{4}$ $\frac{1}{36}$	= ,, 1 in. ,,
£	49	17	9½ $\frac{11}{36}$	=value of 189 yds. 11 in. at 5s. 3¼d.

Grammar.

1. *is*—irreg. incomplete verb *am*, *was*, *been*, pres. ind. 3d pers. sing. agr. with subj. *it*.
sweet—adj. qual. *it*.
to hear—irreg. trans. verb *hear*, *heard*, *heard*, pres. inf.
sheep—noun used as adj. qual. *dog*.
honest—adj. qual. *bark*.
bay—reg. trans. verb pres. inf. (*to* omitted after *hear*).
deep-mouthed—adj. qual. *welcome*.
near—reg. trans. verb pres. ind. 1st pers. plu. agr. with subj. *we*.
our—pronom. adj. qual. *home*.
is—(same as before).
sweet—(same as before).
to know—irreg. trans. verb *know*, *knew*, *known*, pres. inf.
is—irreg. incomplete verb, etc. agr. with subj. *eye*.
will mark—reg. trans. verb, future ind. 3d pers. sing. agr. with subj. *which*.
[*our*—pronom. poss. adj. qual. *coming*.
(*will*) *look*—reg. intrans. verb, future ind. 3d pers. sing. agr. with subj. *which*.
brighter—adj. with some adverbial force qual. *eye*.
come—irreg. intrans. verb *come*, *came*, *come*, pres. ind. 1st pers. plu. agr. with subj. *we*.

2. When we address persons directly, we use the second person; and since a direct command is equivalent to an address, therefore strictly speaking the *imperative* mood can only be used in the second person.

The *first* and *third* person of the imperative may be expressed by means of *let* and an *infinitive*, as, *Let me go*; *Let him come*.

3. The plural of nouns is generally formed by adding *s* to the singular, but *es* must be added when the singular ends in *s*, *x*, *sh*, *ch* soft, *z*, or *o* preceded by a consonant (with few exceptions), as *lass*, *lasses*; *brush*, *brushes*; *match*, *matches*; *topaz*, *topazes*; *fox*, *foxes*; *hero*, *heroes*. Nouns ending in *y*, preceded by a consonant or by *u*, change *y* into *i* and add *es*, as *lady*, *ladies*; *soliloquy*, *soliloquies*. Some nouns ending in *f* or *fe* change the *f* or *fe* into *ves*, as *loaf*, *loaves*; *life*, *lives*.

Geography.

1. The different names given to openings in the land on the coasts of Great Britain and Ireland are :—
Frith—as Frith of Clyde, separating Ayr and Renfrew from Bute, Argyle, and Dumbarton.
Mouth—as Mouth of the Thames, between Essex and Kent.
Bay—Cardigan Bay, west of Cardigan and Merioneth.
Loch—Loch Ryan, north-west of Wigtownshire.
Lough—Lough Swilly, north of Donegal.
Harbour — Waterford Harbour, between Wexford and Waterford.
Haven—as Milford Haven, west of Pembroke.
River—in the case of Kenmare river, west of Kerry.
Names given to narrow passages of water :—
Channel—as North Channel, between Scotland and Ireland.
Strait—Straits of Dover, between Kent and France.
Sound—Sound of Mull, between Mull and Argyle.
Kyle—Kyles of Bute, between Bute and Argyle.
Peculiar are—(1) The *Narrows* of Skye. (2) The *Pentland Frith*.

2. *Mayo*, a maritime county in west of Ireland and north-west corner of the province of Connaught, bounded on west and north by the Atlantic. Its county town is Castlebar. The county is traversed by a range of mountains, but there is a great variety of surface. The coast is much indented by bays. Loch Mask is now memorable as being close to the estate of Captain Boycott, who had to be protected by the Government, 1880.

Donegal, a maritime county in the north of Ireland, bounded on west and north by the Atlantic. It occupies the north-west corner of the province of Ulster. It has a mountainous and boggy surface. The coast is much broken by inlets, the chief being *Loughs Foyle*, *Swilly*, and *Donegal Bay*. There are many unimportant rivers, the chief being the *Foyle* and the *Swilly*. The county town is *Lifford*. Many of the population work at muslin-weaving.

Wicklow, a maritime county of Ireland, bounded on the south by the Atlantic, and east by the Irish Sea. It lies in the south-east corner of Leinster province, and is one of the most picturesque counties in the country. It is very mountainous. The principal rivers are the *Liffey* and the *Slaney*. The pursuits of the people are chiefly agricultural. Wicklow is the county town.

3. The general appearance of the Pennine Chain and of the Cumbrian Group forms a striking contrast. The former consists of a chain of rounded hills or moors extending for two hundred miles, and ending with the picturesque group of the Peak in Derby. The latter consists of a small, compact, circular mass of mountains having a more rugged aspect than the hills in any other part of England. The Pennines have no lakes, but they give rise to many considerable rivers, such as the Tyne, the Wear, the Tees, the numerous branches of the Yorkshire Ouse, all flowing easterly, and the Mersey flowing west. On the other hand, the Cumbrian Mountains give rise to a few unimportant streams, of which the Derwent and Eden are alone worthy of notice; but in their narrow valleys lies a series of the most beautiful lakes, the chief being Keswick Lake, Windermere, and Ulleswater. From this fact the region takes the name of the Lake District.

Music.

1.

E C F A B

Minim. Crotchet. Semibreve. Semiquaver. Quaver.

2.

3. Five tones and two semitones; the latter are placed between the third and fourth and seventh and eighth notes of the scale.

FIRST YEAR.

Pupil-Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Express £1, 4s. 10¾d. as the decimal of £3, 19s. 8d.

2. Add together 2$\frac{3}{8}$ acres 7½ roods $\frac{11}{16}$ poles and 25¼ yards, and find the value of the whole at 5·25 shillings per square yard.

3. Subtract 11s. 9d. from the sum of $\frac{2}{9}$ of a guinea, £$\frac{3}{8}$, and $\frac{1}{8}$ of 5s., and express the result as the fraction, vulgar *and* decimal, of £1, 5s. 0d.

4. What (improper) fraction taken from $3\frac{5}{7}$ of $\frac{2}{3}$ will leave $\cdot 00\dot{9}$?

5. Find the value of 2·425 of 5 cwt. 3 qrs. 16 lbs., at £5 per ton. Answer to decimals of a penny.

FEMALES.

1. A bankrupt's debts amount to £2000, and his property to £775; what will each of his creditors lose in the pound?

2. In what time ought 10 men to perform the same work, which 5 men and 5 boys can do in 15 days, it being given that 3 men can perform the same amount of work as 5 boys?

3. If 100 horses consume a stack of hay 20 ft. long, 11 ft. 3 in. broad, and 31 ft. 6 in. high in 9 days; how long will a stack 18 ft. long, 5 ft. broad, and 14 ft. high supply 80 horses?

4. Find the cost of one million five hundred and ninety-two thousand four hundred and forty-eight articles at £174, 1s. $10\frac{1}{2}$d. each.

Grammar.

1. Parse all the pronouns in the following:—

'That face is thine: thine own sweet smile I see,
The same that oft in childhood solaced me.'—COWPER.

2. Give examples of adverbs which are followed by the dative case.

3. Relative pronouns are said to have a twofold use—(1) to limit and define the antecedent; (2) to introduce some additional statement, when the principal sentence is complete already. Give examples of each use.

Geography.

Answer Question 1 *or* Question 3, *not both.*

1. In what parts of Ireland are the counties of Mayo, Donegal, and Wicklow? Say what you know about each of them.

2. Which of the European capitals are also seaports? Draw little sketch-maps of the adjoining coasts, showing the position of each of them.

3. Describe the course of a traveller, coming down the Seine from Paris, then sailing along the coast to the mouth of the Rhine, and going up the Rhine as far as the Lake of Constance.

History.

1. Give the dates of the Coronation of Egbert, the Accession of Canute, and the Battle of Hastings.

2. Write down the list of English kings from Edward III. to Henry VII., with dates.

3. What sovereigns occupied the throne between 1660 and 1727? Tell their dates.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Sheriffdom.*

Write, in small hand, as a specimen of copy-setting, '*If son to Talbot, die at Talbot's foot.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Music.

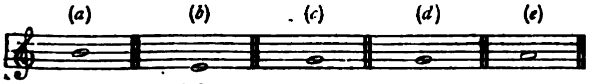
A quarter of an hour allowed for this paper.

1. Write in (*a*) the scale of F (*Fa*), and in (*b*) the scale of G (*Sol*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

(*a*) (*b*)

2. Place its third over (*a*), its fifth over (*b*), its fourth over (*c*), its second over (*d*), and its seventh over (*e*).

(*a*) (*b*) (*c*) (*d*) (*e*)



3. How many minims are equal (in length) to one semibreve?
" crotchets " " one minim?
" quavers " " a dotted minim?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. $\dfrac{£1\ \ 4\ \ 10\frac{3}{4}}{£3\ \ 19\ \ 8} = \dfrac{1195 \text{ farthings}}{3824 \text{ farthings}} = \cdot 3125.$ Ans.

2.
$2\frac{5}{8}$ ac. = 12705 yds.
$7\frac{3}{5}$ ro. = 9196 "
$\frac{4}{11}$ po. = 11 "
$25\frac{1}{4}$ yds. = $25\frac{1}{4}$ "

$21937\frac{1}{4}$ sq. yds. at 5·25s. or 5s. 3d.

$21937\frac{1}{4}$

5s. = $\frac{1}{4}$ of £1	5484	5	0	value at 5s. per yd.
3d. = $\frac{1}{20}$ of 5s.	274	4	3	" " 3d. "
$\frac{1}{4}$ of 5s. 3d. =	0	1	$3\frac{3}{4}$	" of $\frac{1}{4}$ yd. at 5s. 3d.
	£5758	10	$6\frac{3}{4}$	value of $21937\frac{1}{4}$ yds.

3.

	s.	*d.*
$\frac{2}{9}$ guinea =	4	8
£$\frac{3}{8}$ =	7	6
$\frac{1}{8}$ of 5s. =	0	$7\frac{1}{2}$
	12	$9\frac{1}{2}$
	11	9
	1	$0\frac{1}{2}$ = difference.

Now, reducing 1s. $0\frac{1}{2}$d. to the fraction, vulgar and decimal, of £1, 5s., we have

$$\frac{25 \text{ halfpence}}{25 \text{ shillings}} = \frac{25}{600} \text{ halfpence} = \text{vulgar fraction } \frac{1}{24}$$
$$= \text{decimal fraction } \cdot 041\dot{6}.$$

4. This question can take the form ($3\frac{5}{7}$ of $\frac{2}{3}$ — $\cdot 00\dot{9}$), or

$$\left(\frac{26\times 2}{7\times 3} - \frac{1}{100}\right) = \frac{5200}{2100} - \frac{21}{2100} = \frac{5179}{2100}. \text{ Ans.}$$

5. $2\cdot 425 = \frac{2425}{1000} = \frac{97}{40}.$

5 cwt. 3 qrs. 16 lbs. = 660 lbs.;
∴ $\frac{97}{40}$ of 660 lbs. = $1600\frac{1}{2}$ lbs.,
and 1 ton = 2240 lbs.
So 2240 lbs. : $1600\frac{1}{2}$ :: £5,

$$\frac{1600\frac{1}{2}\times 5}{2240} = £\frac{3201}{896} = £3,\ 11\text{s. } 5\cdot 41\dot{0}7142\dot{8}5\text{d. Ans.}$$

FEMALES.

1. The creditors lose £2000 — £775, or £1225;
∴ if £1225 be lost on £2000,

£$\frac{1225}{2000}$ will be lost on £1, or 12s. 3d. Ans.

2. Since 3 men = 5 boys,
∴ 5 men + 5 boys = 8 men.
So 10 men : 8 men :: 15 days : 12 days. Ans.

3.
80 horses : 100 horses :: 9 days.
20 feet : 18 feet.
135 in. : 60 in.
378 in. : 168 in.

$$\frac{100\times 18\times 60\times 168\times 9 \text{ days}}{80\times 20\times 135\times 378} = 2 \text{ days. Ans.}$$

4.
1592448
174

6369792
11147136
1592448

	277085952	0 =	value at £174.
1s. 8d. = $\frac{1}{12}$ of £1	132704	0 =	" 1s. 8d.
2d. = $\frac{1}{10}$ " 1s. 8d.	13270	8 =	" 2d.
$\frac{1}{2}$d. = $\frac{1}{4}$ " 2d.	3317	12 =	" $\frac{1}{2}$d.
	£277235244	0 =	value of whole.

Grammar.

1. *Thine*—pers. pron. 2d pers. fem. (?) sing. attrib. to *face.*
thine own (=*thy own*), pronom. poss. adj. qual. *smile.*
I—1st pers. pron. masc. (agr. with *Cowper*), sing. nom. subj. of *see.*
that—simple rel. pron. antecedent *smile*, neut. sing. nom. subj. of *solaced.*
me—1st pers. pron. masc. (agr. with *Cowper*), sing. obj. of *solaced.*
the same=demonstrative pron. agr. with *smile.*

2. The following words (by some considered prepositions) may be classed as adverbs followed by the dative case—that is, objective governed by *to* understood:—*Nigh, near, next, opposite, like, unlike.*

EXAMPLES.

He overtook me *nigh* (or *near*) the church.
You acted *like* (or *unlike*) yourself.
You stand *next* (or *opposite*) me.

3. The following are examples of relative pronouns limiting and defining the antecedent:—'That is the man *who spoke to me yesterday.*' 'The house *that* (or *which*) *he built still remains.*' The clauses in italics are adjective clauses, the one beginning with *who* defining *the man*, and that beginning with *that* or *which* defining *the house.*

In the following examples the relatives connect co-ordinate sentences:—'I met the guard *who* (= *and he*) told me there had been an accident.' 'At school I studied geometry, *which* (= *and it*) I found useful in after life.'

Geography.

1. *See same question answered in Candidates' Paper of this number.*

2. The following European capitals are also seaports:—*London, Dublin, Lisbon, Amsterdam, Copenhagen, Stockholm, St. Petersburg, Constantinople, Christiania.*

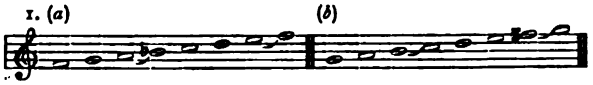
3. A traveller beginning at Paris and coming down the Seine would pass *Versailles*, a short distance from the river on the south bank, then *Rouen*, a cathedral city, and reach *Havre* at the mouth of the river. His course would now turn northwards through the *English Channel*, passing *Dieppe, Abbeville*, and *Boulogne* with its many English residents. In going through the *Straits of Dover*, he would have *Calais*, so long possessed by England, on his right, and *Dover* on his left. Now skirting the coast of *Belgium*, he would pass the seaport of *Ostend*, and reach the coast of Holland. Threading one of the many passages made by the islands at the mouth of the Rhine, he would enter one of the arms of its Delta, and traverse Holland, and on reaching the Prussian frontier, he would sail into the main stream past *Düsseldorf, Cologne*, famed for its perfume and its beautiful cathedral, *Bonn*, with a university, and *Coblentz*, opposite the famous *Ehrenbreitstein.* From Coblentz to *Mayence*, he would enjoy the most magnificent scenery on the river. From Mayence to *Mannheim*, the scenery would also be much admired, and on the next stage he would pass the town of *Spires*, noted for the Diet (1529), and *Strasburg*, with its wonderful clock and cathedral. On reaching *Basle* on the borders of Switzerland, he would find his course lay eastwards to *Schaffhausen* with the falls of the Rhine, and soon afterwards end his journey at *Lake Constance.*

History.

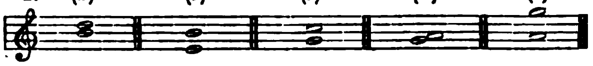
		A.D.
1.	Coronation of Egbert, as king of England,	827
	Accession of Canute,	1017
	Battle of Hastings,	1066
2.	Edward III. began to reign,	1327
	Richard II. ,, ,,	1377
	Henry IV. ,, ,,	1399
	Henry V. ,, ,,	1413
	Henry VI. ,, ,,	1422
	Edward IV. ,, ,,	1461
	Edward V. ,, ,,	1483
	Richard III. ,, ,,	1483
	Henry VII. ,, ,,	1485
3.	Charles II. ,, ,,	1660
	James II. ,, ,,	1685
	William III. and Mary II. began to reign	1689
	Anne	1702
	George I.	1714-27

Music.

1. (*a*) (*b*)



2. (*a*) (*b*) (*c*) (*d*) (*e*)



3. How many minims are equal (in length) to one semibreve? (two).
How many crotchets are equal (in length) to one minim? (two).
How many quavers are equal (in length) to a dotted minim? (six).

SECOND YEAR.

Pupil Teachers at end of Second Year, ***if apprenticed on, or after, 1st May*** **1878; and Pupil Teachers at end of Third Year, if apprenticed before that date.**

FIRST PAPER.

Two hours and a half allowed.

Arithmetic.

MALES.

1. What would be the simple interest, and amount, of £150, for 6 years and 10 months at 4 per cent.?

2. If £3256·75 produces at simple interest for 3·3 years £651·35, what is the rate of interest per cent. per annum?

3. A train starts from London at 9 A.M., and reaches Derby 130 miles distant at 12.15 P.M. A second train starts from London for Derby at 10.15 A.M., and travels 166 yds. per minute faster than the first. At what time will the latter train arrive? Answer to fraction of a *minute.*

4. The interest on a sum of money comes to £202·5 in 12 years at 4·5 per cent. simple interest; required the thousandth part of the principal.

5. If I buy a horse with ·$\dot{4}$ of my money, and sell it again so as to gain 15 per cent. I now invest all but 15s. of what I got for the horse in 3 cows, one of which dying, I sell the remaining two for £96, thus losing 20 per cent. How much had I before buying the horse?

FEMALES.

1. Simplify the following:—

(*a*) $\frac{6}{12}+\frac{3}{5}+\frac{4}{8}+\frac{6}{30}$;

(*b*) $17\frac{2}{3}-\frac{4}{5}-7\frac{5}{6}$.

2. By how much does the sum of $\frac{51}{75}$, $\frac{131}{150}$, $\frac{24}{25}$, $\frac{1}{2}$, and $\frac{2}{3}$ fall short of 4?

3. Divide £2, 13s. 8d. among 7 men, 5 women, and 17 boys, giving each woman $\frac{2}{3}$ of each man's share, and each boy $\frac{2}{3}$ of each woman's share.

4. By selling an acre of land for 60 guineas, I gained $\frac{7}{13}$ of what it cost me; what did it cost me?

Grammar.

1. 'Before a novice can commence the study of any science, he *must* make himself *acquainted* with the terms *employed* in that science.'

(*a*) Point out the principal and adverbial sentence in the above, and show why each is so called.

(*b*) Mention other kinds of subordinate sentences besides adverbial, and give an example of each.

(*c*) Point out, and carefully parse, the participles and auxiliary verbs in the above.

2. What are causal conjunctions? Why are they so called? Give examples.

Geography.

1. Describe the course of a traveller, coming down the Seine from Paris, then sailing along the coast to the mouth of the Rhine, and going up the Rhine as far as the Lake of Constance.

2. Give notes of a lesson on Australia under these heads :—
(*a*) Position, shape, size.
(*b*) British settlements and chief towns.
(*c*) History of these settlements, with dates.
(*d*) Reason why they are all on the coast.
(*e*) Climate and productions.
Illustrate by a map, and refer to the map at each point of your lesson.
N.B.—No Introduction.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. Upon the death of Edward the Confessor, who was the next heir to the crown? What other claimants were there? Discuss their respective claims.
2. How did Henry I. come to the throne? Give the name and descent of his Queen.
3. Who was Henry the Fifth's Queen? What second marriage did she make, and what line of sovereigns descended from it?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Sheriffdom.*

Write, in small hand, as a specimen of copy-setting, '*If son to Talbot, die at Talbot's foot.*'

Composition.

Write full notes of a lesson on the *Sun.*

Euclid.

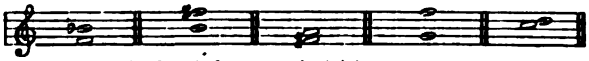
[All generally-understood abbreviations for *words* may be used, but no symbols of *operation* such as —, +, × are admissible.]

1. If two angles of a triangle be equal to each other, the sides also which subtend, or are opposite to the equal angles, shall be equal to one another.
What is a corollary? Give the corollary to this proposition.
2. If from the ends of a side of a triangle there be drawn two straight lines to a point within the triangle, these shall be less than the other two sides of the triangle, but shall contain a greater angle.
What is the *construction* in this proposition?

Music.

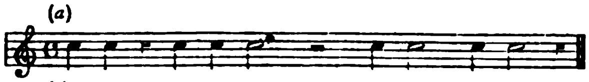
A quarter of an hour allowed for this paper.

1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms :—



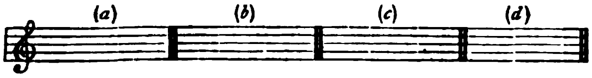
2. Divide (by bars) the notes in (*a*) into measures of common time; those in (*b*) into measures of triple.

(*a*)



(*b*)

3. Write in (*a*) the signature of G (*Soh*), in (*b*) that of F (*Fa*), in (*c*) that of D (*Re*), and in (*d*) that of B♭ (*Se*).



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. Interest of £150 for 6 yrs. 10 mos. at 4 p. c.

$$= \frac{£150 \times 6\frac{5}{6} \times 4}{100} = £41. \text{ Interest.}$$

$$\therefore £150 + 41 = £191. \text{ Amount.}$$

2. £3256·75 : £100 :: £651·35.
$3\frac{1}{3}$ yrs. : 1 yr.

$$\frac{£651{\cdot}35 \times 100 \times 3}{£3256{\cdot}75 \times 10} = £\frac{195405}{32567{\cdot}5} = £6 \text{ p. c. Ans.}$$

3. First train goes 130 miles in 3 hours 15 minutes,
„ 228800 yards in 195 minutes,
„ $\frac{228800}{195}$ yards in 1 minute,

∴ second train goes $1173\frac{1}{3}$ yds. + 166 yds. or $1339\frac{1}{3}$ yds. per min.
and ∴ $1339\frac{1}{3}$ yards : 228800 yards :: 1 minute.

$$\frac{686400 \times 1}{4018} = 170\frac{1670}{2009} \text{ minutes} = 2 \text{ hours } 50\frac{1670}{2009}.$$

The second train will therefore reach Derby at $5\frac{1670}{2009}$ min. past 1.

4. £4·5 : £202·5 :: £100.
12 yrs. : 1 yr.

$$\frac{£100 \times 202{\cdot}5}{4{\cdot}5 \times 12} = £375.$$

1000th part of £375 = £·375 = 7s. 6d. Ans.

5. By selling the two cows for £96, he lost 20 p. c.
∴ to find prime cost of the three, state thus :—
As 80 : 96 :: £100 : £120.

$$\frac{96 \times 100}{80} = £120;$$

∴ £120, 15s. = selling price of the horse.
To find buying price of the horse, state :—
As £115 : £120, 15s. :: £100 : prime cost of horse.

$$\frac{£120, 15s. \times 100}{115} = £105.$$

And £105 = $\frac{5}{9}$ of his original money,
or £105 × $\frac{9}{5}$ = £189. Ans.

FEMALES.

1. (*a*) $\frac{6}{12} + \frac{3}{5} + \frac{4}{8} + \frac{6}{30} = \frac{1}{2} + \frac{3}{5} + \frac{1}{2} + \frac{1}{5} = 1\frac{4}{5}$. Ans.

(*b*) $\left(17\frac{2}{3} - \frac{4}{5} - 7\frac{5}{6}\right) = \left(17\frac{20}{30} - \frac{24}{30} - 7\frac{25}{30}\right)$

$= \left(16\frac{26}{30} - 7\frac{25}{30}\right) = 9\frac{1}{30}$. Ans.

2. The question may be written thus :—

$$4 - \left(\frac{51}{75} + \frac{131}{150} + \frac{24}{25} + \frac{1}{2} + \frac{2}{3}\right)$$

$$= 4 - \left(\frac{102 + 131 + 144 + 75 + 100}{150}\right)$$

$$= 4 - \frac{552}{150} = 4 - 3\frac{17}{25} = \frac{8}{25}. \text{ Ans.}$$

3. If a man gets 1 share, 7 men get 7 shares.
Then a woman „ $\frac{2}{3}$ „ 5 women „ $3\frac{1}{3}$ „
And a boy „ $\frac{4}{9}$ „ 17 boys „ $7\frac{5}{9}$ „

$17\frac{8}{9}$ shares altogether;

∴ every man gets $\frac{£2,\ 13s.\ 8d.}{17\frac{8}{9}} = \frac{644d. \times 9}{161} = 3s.$ Ans.

Every woman gets $\frac{2}{3}$ of 3s., or 2s. Ans.
Every boy gets $\frac{2}{3}$ of 2s., or 1s. 4d. Ans.

4. Here the selling price of the acre is $\frac{20}{13}$ of the prime cost;

∴ the prime cost = 60 guineas × $\frac{13}{20}$, or 39 guineas. Ans.

Grammar.

1. (*a*) '*He must make himself acquainted with the terms employed in that science*' is the principal sentence, because it contains the principal predicate or main proposition; and '*before a novice can commence the study of any science*' is the adverbial sentence, modifying the principal predicate like a simple adverb of *time.*

(*b*) The other kinds of *subordinate sentences* are:—*noun sentences*, which stand in the place of the *noun*, as, He answered, '*I know not the man;*' *adjective sentences*, which do the work of the *adjective*, as, The boy *that neglected his work* was punished.

(*c*) *Acquainted with*—complete participle, belonging to *himself*, from the compound verb to *acquaint with.*
employed—complete part. belonging to *terms*, from the trans. verb *to employ.*
must—verb, auxiliary, ind. mood, pres. tense (defect. in past), 3d pers. sing. agr. with *he.*
can—verb, auxiliary, ind. pres. (past tense *could*), 3d pers. sing. agr. with *novice.*

(*d*) *Because, therefore, for,. since, whereas, seeing that, in order that, that, lest,* are called *causal conjunctions*, because they denote a cause or reason.

Examples.—He will succeed *because* he is in earnest. Do as you are told, *for* much depends upon it. *Since* you desire it, I will look into the matter. *As* we are at leisure, let us see all we can.

Geography.

1. *See same question answered under 'First Year' in this number of Magazine.*

2. NOTES OF LESSON ON AUSTRALIA.

(*a*) *Position.*—Between 10° 40′ and 39° 12′ S. lat., and between 113° and 153° 39′ E. long. *Shape.*—Trapezoidal or of an irregular onion form. *Size.*—2500 miles from E. to W., 1970 miles from N. to S., area about 3,000,000 square miles, or ¼ less than Europe.

(*b*) British settlements and chief towns:—

New South Wales, .	Sydney, Newcastle, Bathurst.
Victoria, . . .	Melbourne, Geelong, Ballarat.
S. Australia, . .	Adelaide, Kooringa.
W. Australia, . .	Perth, Freemantle.
Queensland, . .	Brisbane, Ipswich, Rockhampton.

(*c*) *New South Wales*—so named by Cook—founded 1788—a penal settlement at first—ceased to be such 1840—new life given to colony after discovery of gold 1851. *Victoria*—settled 1835—first called Australia Felix—colonists came from Tasmania—discovery of gold caused a great influx of adventurers—soon became the foremost of Australian colonies. *S. Australia*—proclaimed a colony 1839—suffered much from over-speculation—assisted by Home Government—discovery of copper mines at Burra-Burra hastened its prosperity. *W. Australia*—settled 1829—called first Swan River Settlement—from various causes has not been so prosperous as the other colonies. *Queensland*—proclaimed a colony 1859—formerly part of New South Wales, and called Moreton Bay Settlement.

(*d*) The mountain ranges of Australia are all on or near the coast, and this fact combined with the impassable character of these chains, and the uninviting nature of the interior, caused the settlements to be founded along the seaboard, where there are many rivers and general fertility.

(*e*) Its seasons the reverse of ours—being nearer the equator than Great Britain, its temperature is much higher—monsoons blow in the northern half—westerly winds prevail in south—speaking generally, the settled districts are dry and healthy—in New South Wales, Victoria, and S. Australia, these three peculiarities may be noted: (1) *long droughts*, very destructive; (2) hot *winds*, blowing from the interior; (3) sudden transition from heat to cold. *Productions.*—Gold, copper, wool, tallow—land better suited for pasture than tillage—vegetation goes on all the year, and is peculiar, consisting chiefly of gum trees, acacias, and heaths—food plants of Europe have been introduced—native animals nearly all pouched—*e.g.* Kangaroo—remarkable birds are lyre-bird, emu, and black swan.

History.

1. On the death of Edward the Confessor, three claimants for the throne arose, namely:—(1) Edgar Atheling, the grandson of Edmund Ironside, who by right of hereditary succession was the next heir to the crown. (2) Harold II., who was chosen by the Witan on account of his great influence in the kingdom; and (3) William, Duke of Normandy, who was said to have got the promise of the throne on the occasion of his paying a visit to Edward. The latter is said to have left a will, naming William his heir.

2. Henry I., on hearing of the death of Rufus, seized the royal treasures, and being supported by the most powerful of the barons, got himself proclaimed king. His elder brother Robert was absent on a crusade, and though he returned to claim his rights, yet he could not make head against the usurper. Henry married Matilda, daughter of Malcolm, king of Scotland, and Margaret, the daughter of Edward, son of Edmund Ironside. Thus Henry's marriage with Matilda united the Saxon and Norman lines.

3. Henry V. married Catharine, daughter of the king of France. After Henry's death, she married Owen Tudor, a Welsh gentleman, and from this marriage sprang the Tudor line of sovereigns, of which Henry VII. was the first.

Composition.

NOTES OF A LESSON ON THE SUN.

1. *What is the sun?*—Centre of the solar system—solar system means the whole body of stars and planets of which our earth is one—one boy may be placed to represent the sun, and several other boys at various distances made to walk in circles round him—appearance of the sun, bright, luminous—the eye cannot look on him at his midday splendour. *Size.*—Said to be a globe more than a million times greater than our earth.

Distance from the earth.—About 95 millions of miles.

Effect on the earth.—The main source of heat which the earth possesses—the source of all the light—the support of all the animal and vegetable life in the world—the heat of the sun acting unequally the cause of the winds—heating of soil produces evaporation from watery surfaces, and cooling of vapours causes rain—the tides also depend on the attractive force of the sun as well as of the moon.

Eclipses of the sun—caused by moon coming between earth and sun—some reference may now be made to the causes of day and night, the seasons, and zones, 'rising and setting.'

Euclid.

1. Prop. 6, Bk. I.

A corollary is a conclusion easily derived from the demonstration of a proposition. The conclusion which we may arrive at from this exposition of the 6th prop. is that equiangular triangles are also equilateral.

2. Prop. 21, Bk. I.

The construction in this proposition is the producing of one line to meet the side of the triangle.

Music.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May* **1878; and Pupil Teachers at end of Fourth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. On what sum will the simple interest amount to £168·778125 in 5 years at 4·5 per cent.?

2. I buy 100 qrs. of wheat, and sell it again so as to gain 15 per cent. With the money received for the wheat I buy some hay, and sell it for £259, 8s. 9½d., thereby losing 6 per cent.; what did I give for the wheat?

3. If 3 per cent. more be gained by selling a horse for £83, 5s. 0d. than by selling it for £81, which was the original price of the horse?

4. If 17½ gals. of spirits worth 12s. a gal. are put into a vat with 25 gals. of spirits worth 15s. a gal., and 30 gals. worth 18s. a gal., how much water should be added to make the resulting mixture worth 12s. 6d. a gallon?

5. A corn merchant's prices are 25 per cent. above cost price. If he allows a customer 12 per cent. on the bill which he sends in to him, what profit does the corn merchant realize?

FEMALES.

1. Simplify the expressions—

(*a*) $5 - 3{\cdot}22 + 2{\cdot}333 - 1{\cdot}4444.$

(*b*) $\frac{2{\cdot}004}{\cdot167} \times \frac{3{\cdot}375}{4}.$

2. Find the value of ·5 of a shilling + ·7 of a crown + ·125 of a pound.

3. The price of ·0625 lbs. of coffee being ·4583s., what is the cost of ·075 of a ton?

Grammar.

1. If enlargements are words and phrases attached to the nouns in a sentence, and extensions words or phrases attached to the verbs or predicates, assign all the enlargements and extensions which occur in the following to their proper classes :—

(*a*) 'The harp, his sole remaining joy,
Was carried by an orphan boy.'

(*b*) 'Ocean and earth, the solid frame of earth
And ocean's liquid mass, in gladness lay
Beneath him.'

(*c*) 'The sheen of their spears was like stars on the sea,
When the blue wave rolls nightly on deep Galilee.'

2. Parse any participles, or verbs in the infinitive mood, which occur in the following, and give the meaning of the passage in simple words of your own :—

'Blest be the art that can immortalize
The art that baffles time's tyrannic claim
To quench it.'

3. With what Latin preposition are the words *support*, *suffice*, *effect*, *destroy*, compounded? Give the meaning of the preposition in each case.

Geography.

1. Give notes of a lesson on Australia, under these heads :—
(*a*) Position, shape, size;
(*b*) British settlements and chief towns;
(*c*) History of the settlements, with dates;
(*d*) Reason why they are all on the coast;
(*e*) Climate and productions.

Illustrate by a map, and refer to the map at each point of the lesson.

N.B.—No Introduction.

2. Describe a journey from the Victoria Nyanza down the Nile, and then by land to Jerusalem, the Sea of Galilee, Mount Lebanon, and the town of Acre.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. How was Henry VII. related to Edward III.? Do you think that this relationship gave him a right to the throne?

2. Who was Oliver Cromwell? Sketch his career and character.

3. Mention some leading statesmen of the time of George III., and describe the general policy of one of them. What would you say of the king's power in that reign?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Sheriffdom*.

Write, in small hand, as a specimen of copy-setting, '*If son to Talbot, die at Talbot's foot.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally-understood abbreviations for *words* may be used, but no symbols of *operations*, such as −, +, ×, are admissible.]

1. The opposite sides and angles of a parallelogram are equal to one another, and the diameter bisects it, that is, divides it into two equal parts.

Two parallel lines cut a series of parallel lines; show that the parts of the latter intercepted by the former have their middle points in the same straight line.

2. To describe a parallelogram equal to a given rectilineal figure, and having an angle equal to a given rectilineal angle.

What is the *construction* in this proposition?

Algebra.

1. Divide 1 by $1-x+x^2$ to four terms.

2. Simplify :—

(1) $\frac{3a-4b}{6}+\frac{2b-5a}{9}-\frac{5a-6b}{12}$.

(2) $\frac{a^2}{(a-b)(a-c)}+\frac{b^2}{(b-a)(b-c)}+\frac{c^2}{(c-a)(c-b)}$.

3. Solve the equations :—

(1) $\frac{1}{6}(x+2)+\frac{1}{8}(x-3)-\frac{1}{4}x=\frac{12}{24}$.

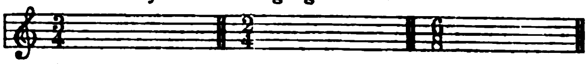
(2) $9-\frac{2x-3}{2x-2}=\frac{5x+3}{x-1}$.

Music.

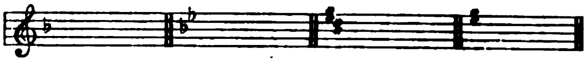
A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of D (*Re*). Mark the places of the semitones :—

2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures :—



3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature :—



ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. £4·5 : £168·778125 :: £100.
5 years : 1 year.

$£\frac{100\times168·778125}{4·5\times5}=£\frac{16877·8125}{22·5}$
$=£750·125=£750$, 2s. 6d. Ans.

2. To find the cost of the hay, state thus :—

94 : 100 :: £259, 8s. 9·6d.

$=\frac{62265·6\text{d.}\times100}{94}=66240\text{d.}=£276.$

To find the prime cost of wheat which was sold for £276, state thus :—

115 : 100 :: £276.

$\frac{£276\times100}{115}=£240$, price of the 100 qrs.

3. A difference of £2, 5s. is equal to 3 p. c. of original price;
∴ £3 : £2, 5s. :: £100 : £75. Ans.

4.

		s.
$17\frac{1}{2}$ galls.	at 12s. =	210
25 ,,	15s. =	375
30 ,,	18s. =	540
$72\frac{1}{2}$ galls.		1125s.

Now galls. required × 12s. 6d. = 1125s.
∴ ,, $=1125\div12\frac{1}{2}=90$.
Then the water to be added $=90-72\frac{1}{2}=17\frac{1}{2}$ galls. Ans.

5. If £100 represents cost price, then £125 represents the corn merchant's price.

$\frac{12}{100}$ of £125 = £15,

or the corn merchant gets £125 − 15, or £110 = a clear profit of 10 per cent.

FEMALES.

1. (*a*) (5 − 3·22 = 1·78); (1·78 + 2·333 = 4·113); (4·113 − 1·4444) = 2·6686 Ans.

(*b*) $\frac{2·004}{·167}\times\frac{3·375}{4}=12\times·84375=10·125.$

2.

	s.	d.
·5 of 1s. =	0	6
·7 of 5s. =	3	6
·125 of £1 =	2	6
	6	6 Ans.

3. $\cdot 0625$ lbs. : $\cdot 075$ ton :: $\cdot 4583$s.
or $\cdot 0625$ lbs. : 168 lbs. :: 5·5d.

$$=\frac{5\cdot 5\text{d.} \times 168}{\cdot 0625} = 14784\text{d.} = £61, 12\text{s.}$$

Grammar.

1. (*a*) 'His sole remaining joy'—an enlargement of *harp* (noun phrase).

'By an orphan boy'—extension of *was carried* (instrument).

(*b*) 'The solid frame of earth'—enlargement of *earth* (noun phrase).
'Ocean's liquid mass'—enlargement of *ocean* (noun phrase).
'In gladness'—extension of *lay* (manner).
'Beneath him'—extension of *lay* (place).

(*c*) 'Of their spears'—enlargement of *sheen* (adjective phrase).
'When the blue . . . on deep Galilee'—extension of predicate *was like stars on the sea* (adverbial sentence).
'The blue'—enlargement of *waves* (adjective).
'Nightly'—extension of *rolls* (time).
'On deep Galilee'—extension of *rolls* (place).

2. *Blest*—complete part. qual. *art*.
be—pres. inf. of incompl. verb *am, was, been*. The full expression = *Let the art* (*to*) *be blest*.
to quench—pres. inf. of reg. verb *quench*.

The lines may be rendered thus:—
All honour to the skill which is capable of preventing the works effected by genius from being destroyed by the changes of time.

3. Support is compounded with *sub*, meaning *under*.

Suf-fice	„	„ „	„ „
Ef-fect	„	„ *ex*	„ *out of*.
De-stroy	„	„ *de*	„ *down* or *from*.

Geography.

1. *See same question answered under Second Year in this number of Magazine.*

2. In following the course of the Nile from its chief reservoir, the Victoria Nyanza (discovered by Sir Samuel Baker and Captain Speke), to its delta, we have a journey of 3300 miles. After leaving the Victoria Nyanza, the river passes through the Albert Nyanza, traverses a level region to Gondokoro, then flows with many windings first north-west, then north-east, receives its first great branch, the Bahr-el-gazal, from the west, takes a turn to the east, then south, and receives the Sobat from the east. It then strikes north to Khartoum, where it is joined by the Bahr-el-Azrek, long supposed to be the main river, from Abyssinia. It continues north past the ruins of Meroe, the first cataract, and Shendy. The Atbara, the third great tributary, now joins it, under the name of the Takazze, and winding through Nubia, past Berber, New Dongola, Ipsambool, and Derr, it enters Egypt at Assouan, and flows the whole length of the country, which it fertilizes, passing ruins of Thebes, Kenneh, Siout, Ghizeh, to Cairo, where we will leave it to enter the Mediterranean by three main streams, distinguished respectively as the Alexandria, Rosetta, and Damietta mouths. Leaving the Nile, we cross Egypt to the canal through the Isthmus of Suez. When in this neighbourhood, it would be very interesting to follow as nearly as possible the route taken by the Israelites through the desert to Horeb, Sinai, and other noted spots, without taking so long on the journey. On reaching Jerusalem, we must pay a visit to Bethlehem, the Dead Sea, etc. On our journey north from Jerusalem, we could render the route very pleasant by searching for those places so famous in Bible times, Bethel, Jericho, Mount Gerizim, Shechem, Dothan, Mount Gilboa, Nain, Mount Tabor; and after a sail on the Sea of Galilee, a short journey north-east will take us to Mount Lebanon, with the well-known cedars. To the south-east lies Acre, on a considerable bay; here Sir Sydney Smith baffled Napoleon in his attempts to take the town.

History.

1. Henry VII. was related to Edward III. through his grandfather Owen Tudor, who was the son of Margaret, great-granddaughter of John of Gaunt, the third son of Edward III. His title to the throne was so defective that he himself hesitated whether to claim it by descent, by conquest, or by his marriage with Elizabeth, who represented the House of York.

2. Oliver Cromwell was the son of Robert Cromwell, and born at Huntingdon 1599. He was returned as member for his native town to the third Parliament of Charles I. 1628. He was again elected in 1640. He was associated with Hampden, Pym, and other popular leaders, and was one of the first to advocate resistance to the king's measures. In 1642 he received a captain's commission, and raised a troop of horse in his native county. So well were his soldiers disciplined, that after the battle of Marston Moor they got the name of Cromwell's Ironsides. At Naseby, Cromwell commanded the right wing, and Ireton, his son-in-law, the left. Charles was totally defeated in this battle, and ultimately gave himself up to the Scots at Newark. In 1649, when it was settled at his trial that the king should be executed, Cromwell is said to have reluctantly assented; but when convinced of the necessity of Charles's death, he seems to have had no hesitation in carrying the decision of the court into effect. After the execution, Cromwell became a principal member of the Council of State. He quelled a mutiny in the army, crossed over and conquered Ireland, returned to make war on Prince Charles and the Scots, whom he conquered at Dunbar and Worcester. In 1653 he expelled the Long Parliament, and was elected Protector of the Commonwealth, which office he held till his death in 1658.

Cromwell has now come to be regarded as one of England's greatest rulers. He was a man of most marvellous genius, who after the age of forty became an invincible general and a wise statesman. He was a zealous patriot, and an enthusiast in religion. To him are we indebted for the great lesson of religious toleration.

3. The leading statesmen of the time of George III. were:—*Washington* (in America), *William Pitt* (the Tory), and *Fox*, *Burke*, and *Sheridan*, great Whig orators. The general policy of Pitt was one of active reform, and he faced the most difficult problems in finance, politics, and religion, from which Walpole had shrunk. By a reduction of the custom duties, he checked smuggling by making it unprofitable. Though he failed in Parliamentary reform, yet this was counterbalanced by the success of his financial policy, which introduced a saving in every department of the public service and the reduction of taxation. His policy towards France was to bring the French War to an end by English mediation, and to leave the French to arrange their own internal affairs. He was a Peace Minister, and was forced into a war policy against his will by the panic and enthusiasm of the people.

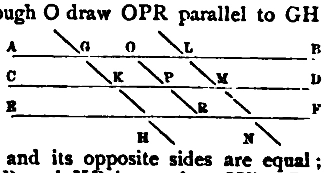
The king's power in the reign of George III. was a monarchy limited by the Commons, who did not represent the democracy fairly until after the Reform Bill of 1832.

Euclid.

1. Prop. 34, Book I.

Rider.—Let the two parallels GH, LN cut a series of parallels AB, CD, EF respectively in G, K, H, L, M, N. Then the middle points of GL, KM, HN shall lie in the same straight line.

Bisect GL in O, and through O draw OPR parallel to GH or LN; and meeting KM in P, and HN in R, KM and HN shall be bisected respectively in these points. Since OPR is parallel to GKH, each of the figures GOPK, KPRH is a parallelogram, and its opposite sides are equal; therefore GO is equal to KP, and KP is equal to HR. But GO is the half of GL; therefore KP is half of KM, and HR half of HN, for GL = KM = HN.—Q. E. D.



2. Prop. 42, Book I.

Algebra.

1.
$$\begin{array}{l} 1 - x + x^2 \,)\, 1 \,(\, 1 + x - x^3 - x^4 \\ \quad\quad\quad\;\; \underline{1 - x + x^2} \\ \quad\quad\quad\quad\;\; x - x^2 \\ \quad\quad\quad\quad\;\; \underline{x - x^2 + x^3} \\ \quad\quad\quad\quad\quad\quad\;\; - x^3 \\ \quad\quad\quad\quad\quad\quad\;\; \underline{- x^3 + x^4 - x^5} \\ \quad\quad\quad\quad\quad\quad\quad\quad\; - x^4 + x^5 \\ \quad\quad\quad\quad\quad\quad\quad\quad\; \underline{- x^4 + x^5 - x^6} \end{array}$$

2. (1) L. C. M. of denominators = 36;

$$\therefore \text{ the expression } = \frac{18a - 24b + 8b - 20a - 15a + 18b}{36}$$

$$= \frac{2b - 17a}{36}.$$

(2) Changing the signs of the numerators and denominators to arrange terms, the expression

$$=\frac{a^2}{(a-b)(a-c)}-\frac{b^2}{(b-c)(a-b)}+\frac{c^2}{(a-c)(b-c)}.$$

L. C. denominators $=(a-b)(a-c)(b-c)$,
or $=a^2b-a^2c-b^2a+b^2c+c^2a-c^2b$;

therefore the expression becomes

$$\frac{a^2(b-c)}{(a-b)(a-c)(b-c)}-\frac{b^2(a-c)}{(a-b)(a-c)(b-c)}+\frac{c^2(a-b)}{(a-c)(b-c)(a-b)}$$

$$=\frac{a^2b-a^2c-b^2a+b^2c+c^2a-c^2b}{a^2b-a^2c-b^2a+b^2c+c^2a-c^2b}$$

$$=1.$$

3. (1) L. C. M. of denominators $=24$; therefore the expression becomes

$$3x+6+4x-12-6x=19,$$
$$3x+4x-6x=19-6+12,$$
$$x=25.$$

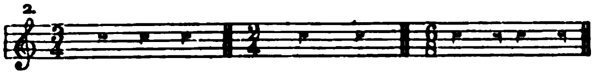
(2) L. C. M. of denominators $=2(x-1)$; therefore the expression becomes

$$9(2x-2)-2x+3=10x+6,$$
$$18x-18-2x+3=10x+6,$$
$$18x-2x-10x=6-3+18,$$
$$6x=21,$$
$$x=3\tfrac{1}{2}.$$

Music.

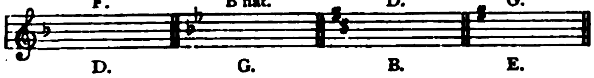
1.

2.



3.

F. B flat. D. G.



D. G. B. E.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May* 1878; and Pupil Teachers at end of Fifth Year, if apprenticed before that date.

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the cost of papering a room 12 feet high, 18 feet long, and 15 feet wide, at 4s. a sq. yard (labour charged extra 2½d. per sq. yard), and of colouring the ceiling at 8½d. per square yard.
2. Find the difference between 20·25 guineas, and the present worth of a bill for £21, 10s. 0d. due in 3 months, reckoning interest at 4 per cent. per annum.
3. A sum is laid out in the 4 per cents., standing at 102½, and one half-year's dividend received upon it; the stock is then sold at 105⅜, and the whole increase of capital, including the half-year's interest, is £253, 10s. 0d. Find the original sum.
4. A and B run a mile race; at first, A runs 11 yds. to B's 10, but after A has run ½ a mile he gets tired, and runs 9 yards in the time in which he at first ran 11, B running at his original rate. Which will win, and by how much?
5. From $\frac{1}{14}$ of $\sqrt[3]{5\cdot919918129}$, take $\frac{1}{181}$ of $\sqrt[3]{01\cdot770404177}$.

FEMALES.

1. The sum of £463, 16s. is to be raised in a parish, the assessment of which is £6184; what is the rate in the pound?
2. If 858 men in 6 months consume 234 quarters of wheat, how many quarters will be required for the consumption of 979 men for 3½ months?
3. Find the amount of £417, 7s. 9d. for 1 year 10 months at 4⅝ per cent. per annum.
4. A man owes three creditors, A, B, and C, respectively, £175, £210, and £265; his property is worth £422, 10s.; what ought they each to receive?

Grammar.

1. 'He scarce had finished, when such murmur filled
Th' assembly, as when hollow rocks *retain*
The sound of *blustering* winds, which all night long
Had roused the sea, now with hoarse *cadence lull*
Seafaring men *o'er watched.*'

(*a*) Point out all the subordinate sentences in the above, and assign each to its proper class.
(*b*) Parse the words in italics, and give their meaning and derivation, if you know them.

2. The following words in our language are said to be of Latin-French origin (*i.e.*, they are Latin words that have come to us through the medium of the French). Show that this is so, and give examples of other words of the same kind :—*charm, clear, journal, siege, treason.*
3. How did words of the above character (French-Latin) find their way into our language?

Geography.

Answer Q. 1 *or* Q. 3, *not both.*

1. Give notes of a lesson to an advanced class on '*Trade Winds and Monsoons,*' and their effects on climate and navigation.
2. Draw a full map of the United States.
3. Describe, as fully as you can, *Peru, Bolivia,* and *Chili.*

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. Show how the English Crown passed from the House of Normandy to that of Anjou, and from the House of Stuart to that of Brunswick.
2. Who was the first English Sovereign proclaimed King of Ireland? What Irish title had been borne by his predecessors, and what was its meaning under the feudal system?
3. Who was John Wilkes? What constitutional principle was involved in the dispute about his seat for Middlesex?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Sheriffdom.*

Write, in small hand, as a specimen of copy-setting, '*If son of Talbot, die at Talbot's foot.*'

Composition.

Write an essay on '*The British Empire is one on which the sun never sets.*'

Euclid.

[All generally-understood abbreviations for *words* may be used, but not symbols of *operations*, such as —, +, ×.]

1. If the square described upon one of the sides of a triangle be equal to the squares described upon the other two sides of it; the angle contained by these two sides is a right angle.
2. If a straight line be divided into two equal, and also into two unequal parts, the squares on the two unequal parts are together double of the square on half the line, and of the square on the line between the points of section.

Divide a straight line into two parts, so that the sum of their squares may be the least possible.

Algebra.

1. How many minutes is it to four o'clock, if three-quarters of an hour ago it was twice as many minutes past two o'clock?
2. Find the sum and difference of

$$\left(\frac{x}{a}+\frac{a}{x}\right)\ \left(\frac{y}{b}+\frac{b}{y}\right) \text{ and } \left(\frac{x}{a}-\frac{a}{x}\right)\ \left(\frac{y}{b}-\frac{b}{y}\right).$$

3. Solve the equations :—

$$1.\quad 33x^2 - 131x = 52.$$

$$2.\quad \frac{2x-25}{3} - \frac{6-y}{7} = \frac{2(x-7)}{5}$$

$$\frac{29-y}{8} - \frac{3x-1}{10} = \frac{4-y}{3}$$

Mensuration.

1. The area of a rectangular field contains 975744 square feet, and one of the sides is $3\frac{1}{3}$ times as long as the other. What is the length of each side?

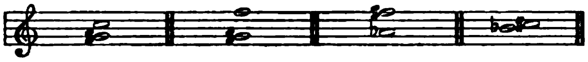
2. The diameter of a circle is 476 links; find its area in acres, etc.

Music.

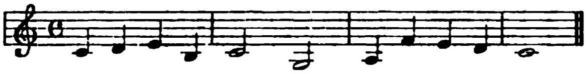
A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of D (*Re*) minor in every form with which you are acquainted. Mark the places of the semitones, and augmented intervals.

2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms :—



3. Write the following, at the same pitch, on the bass stave :—



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. (1) Area of the side walls $=(12\text{ ft.}\times 18\text{ ft.})\times 2 = 432$ sq. ft.
 ,, end ,, $=(15\text{ ft.}\times 12\text{ ft.})\times 2 = 360$,,

792 sq. ft.

		£	s.	d.
792 sq. ft. = 88 sq. yds. at 4s.	= 352s. =	17	12	0
88 ,, at $2\frac{1}{2}$d.	= 220d. =	0	18	4

∴ cost of papering room = £18 10 4. Ans.

(2) Area of ceiling = 18 ft. × 15 ft. = 270 sq. ft. = 30 sq. yds.
30 sq. yds. at $8\frac{1}{2}$d. = 255d. = £1, 1s. 3d. Ans.

2. Interest of £100 for 3 months at 4 p. c. per annum = £1.
Amount ,, ,, ,, ,, = £101;

∴ £101 : £21·5s. :: £100 : present worth.

$$\frac{£100 \times 21{\cdot}5}{101} = \frac{2150}{101} = £21\ 5s.\ 8\tfrac{82}{101}d.$$

and 20·25 guineas = £21 5s. 3d.

therefore the difference = £0 0 $5\frac{82}{101}$. Ans.

3. Half-year's dividend on every $£102\frac{1}{2} = £2$
Profit from sale of every ,, $= £2\frac{7}{8}$

Total gain on ,, $= £4\frac{7}{8}$

The question may now be stated thus :—If every $£102\frac{1}{2}$ of stock bring a gain of $£4\frac{7}{8}$, what amount of stock must be sold to have a profit of $£253\frac{1}{2}$?

$$4\tfrac{7}{8} : 253\tfrac{1}{2} :: 102\tfrac{1}{2} : \text{stock sought,}$$

$$\text{or } \frac{39}{8} : \frac{507}{2} :: £\frac{205}{2} : £\frac{8\times 507\times 205}{39\times 2\times 2}$$

$$= £\frac{2\times 13\times 205}{1} = £5330.\ \text{Ans.}$$

4. When A has run $\frac{1}{2}$ mile or 880 yards, B has run $\frac{10}{11}$ of 880 or 800 yards; A has therefore 880 yards, and B 960 yards still to run.

When B has finished his mile, A has only run $\frac{9}{10}$ of 960 or 864 yards, and of course has 16 yards to make up when B has finished, or B wins by 16 yards.

5. (*a*) Cube root (first method).

$$5{\cdot}919918129\,(1{\cdot}809$$

$$1^3 = 1$$

$$\begin{array}{rr|l}
3\times(10)^2 = & 300 & 4919 \\
3\times 10\times 8 = & 240 & \\
8^2 = & 64 & \\
\hline
604 \times 8 = & & 4832 \\
 & & 87918129 \\
3\times(1800)^2 = & 9720000 & \\
3\times 1800\times 9 = & 58600 & \\
9^2 = & 81 & \\
\hline
9778681\times 9 = & & 87918129
\end{array}$$

$$\frac{1}{54}\text{ of } 1{\cdot}809 = \frac{1{\cdot}809}{6\times 9} = \frac{{\cdot}201}{6} = {\cdot}0335.$$

(*b*) Cube root (second method).

$$61{\cdot}770404177\,(3{\cdot}953$$

$$3^3 = 27$$

$$\begin{array}{rr|l}
 & & 34770 \\
3^2\times 300 = & 2700 & \\
9{,}9\times 9 = & 891 & \\
\hline
3591\times 9 = & & 32319 \\
9^2 = & 81 & 2451404 \\
\hline
 & 456300 & \\
117{,}5\times 5 = & 5875 & \\
\hline
462175\times 5 = & & 2310875 \\
5^2 = & 25 & 140529177 \\
 & 46807500 & \\
11853\times 3 = & 35559 & \\
\hline
46843059\times 3 = & & 140529177
\end{array}$$

$$\tfrac{1}{201}\text{ of } 3{\cdot}953 = {\cdot}0196\dot{6}$$
$${\cdot}0335$$

$$\text{Sum of } (a) \text{ and } (b) = {\cdot}0531\dot{6}$$

$$= \frac{5316 - 0531}{90000} = \frac{4785}{90000} = \frac{319}{6000}.\ \text{Ans.}$$

FEMALES.

1. The question is this :—If £463, 16s. is raised from £6184, how much can be raised from £1?

∴ the statement is £6184 : £1 :: £463, 16s.

$$\begin{array}{r}
£\quad\ s. \\
6184)\,463\quad 16\,(1s.\ 6d.\ \text{Ans.} \\
20 \\
\hline
9276 \\
6184 \\
\hline
3092 \\
12 \\
\hline
37104 \\
37104 \\
\hline
\end{array}$$

2. 858 men : 979 men :: 234 qrs. : x,
6 months : $3\frac{1}{2}$ months :: x : qrs. required.

$$\frac{234\text{ qrs.}\times 979\times 7}{858\times 12} = \frac{39\times 89\times 7}{78\times 2} = \frac{89\times 7}{2\times 2} = \frac{623}{4}$$

$$= 155\tfrac{3}{4}\text{ qrs. Ans.}$$

3. $\frac{£417,\ 7s.\ 9d. \times 1\frac{5}{6} \times 4\frac{3}{8}}{100} = \frac{£417,\ 7s.\ 9d. \times 11 \times 35}{100 \times 6 \times 8}$

$= \frac{£417,\ 7s.\ 9d. \times 77}{960}.$

		£	s.	d.
		417	7	9
				11
		4591	5	3
				7
960	12)	32138	16	9
	10)	2678	4	$8\frac{3}{4}$
	8)	267	16	$5\frac{27}{40}$
		33	9	$6\frac{267}{320}$
Adding the principal,		417	7	9
Amount=		£450	17	$3\frac{267}{320}$

4. Since A's is £175
B's ,, 210
C's ,, 265

Total, £650

650 : 175 :: £422, 10s. : £113, 15s. A's share.
650 : 210 :: £422, 10s. : £136, 10s. B's ,,
650 : 265 :: £422, 10s. : £172, 5s. C's ,,

Grammar.

1. (*a*) The subordinate sentences are :—

(1) 'When such murmur . . . assembly.' Adverbial of *time* modifying 'principal sentence.'
(2) 'As when hollow . . . winds.' Adverbial of *manner*, modifying (1).
(3) 'Which all night . . . sea.' Adjective qualifying *winds*.
(4) 'Now with hoarse . . . o'er-watched.' Adjective, *same as* (3).

Note.—(2) may be analysed thus :

(*a*) 'As (fills the hollow rocks),' *adj.* to *murmur*.
(*b*) 'When hollow, etc.,' adverbial of *manner* to (*a*).

(*b*) PARSING.

retain—verb, transitive, weak conj. indic. mood, pres. tense, plur. 3d pers. agr. with subj. *rocks*.
blustering—verbal adjective, qualifying *winds*.
cadence—noun, abstract, neut. sing. obj. governed by *with*.
lull—verb, trans. weak conj. indic. mood, pres. tense, plur. 3d pers. subject (*which*).
o'er-watched—adjective qualifying *men*.

(*O'er* has an adverbial force, but the two words are properly parsed as one.)

DERIVATION.

retain—Latin *re*, again, *teneo*, I hold.
blustering—Sax. *blæsan*, to blow.
cadence—Latin (*cado*) *cadens*, falling.
lull—German, *lullen* or *lollen*, to sing.
o'er—Sax. *ofer*, *-er* comparative ending.
watched—Sax. from *wake*. *k* is modified.

2. *English.*	*French.*	*Latin.*
charm	charme	carmen
clear	clair	clarus
journal	journal	diurnus
siege	siége	sedere, sessio
treason	trahison	traditio
chief	chef	caput
poor	pauvre	pauper
nourish	nourir	nutrire

3. French-Latin words found their way into our language partly during the Norman-French rule after the Conquest, but mostly through writers, such as Chaucer, introducing French words of Latin origin into their works. To the court and times of Charles II. we owe a great many French terms.

Geography.

1. NOTES OF A LESSON ON TRADE WINDS AND MONSOONS.

Causes.—Trade winds are cold currents of air flowing from polar regions to replace warmer air constantly ascending from tropics, and finding its way among upper strata of atmosphere back to regions in which cold currents take their rise.

Direction.—Nearly due west (but slightly south or north, according as it is a north-east or south-east trade wind), caused by the rotation of the earth on its axis from west to east.

Where they blow.—In the Atlantic and Pacific all the year round in a belt 30° on each side of equator. In Indian Ocean they blow from east to west from November to March, but from April to October they blow from the south-west. These are called in India the *monsoons*.

Benefits to Commerce.—Before the invention of steamers, great helps to navigation. Got their name from their assistance to trade. Every ship from Europe to West Indies, Brazils, India, or Peru, passed through the 'Trades,' and the seamen generally found them regular and steady to help them on their course. The same happened to assist those who sailed the Pacific between America and Asia.

Effect on climate.—These winds have the effect of giving the alternation of dry and wet seasons to the regions lying within their influence, the latter moderating the heat and fertilizing the soil.

In giving lesson, reference to be made to the Terrestrial Globe.

3. *Peru* and *Bolivia*, traversed throughout their whole length by two parallel ranges of the Andes, which divide the country into three physical regions—(1) The Coast region, extending from the coast of Pacific to base of the Andes, 60 miles in breadth; (2) Central region, consisting of a plateau; (3) Eastern region, consisting of immense plains covered with vast forests, extending up the mountain-sides.

Towns in *Peru.*—*Lima*; *Callao*, port of Lima; *Arequipa*; *Cuzco*, ancient capital of the Incas; *Pasco*, up in the Andes, most elevated city in the world.

In *Bolivia.*—*Chuquisaca*; *Potosi*, has richest silver mines in the world; *Cochabamba*, 'granary of Peru;' *La Paz*.

Climate.—Coast region arid, rainless, barren; Central, mild and salubrious; Eastern, hot and humid valleys, and table-land productive.

Productions.—Peruvian bark most important. Precious metals are chief source of wealth.

Animals include llama, used as a beast of burden, and alpaca, useful for its wool.

Chili consists of a long narrow strip between the Andes and the Pacific, formed chiefly of mountain slopes. The Andes attain their highest elevation here.

Towns.—*Santiago*, amid beautiful scenery; *Valparaiso*, 'Vale of Paradise;' *Concepcion*; *Valdivia*, a penal settlement; *Copiapo*.

Climate.—North, dry and barren; centre, very beautiful and fertile.

Productions similar to those of Peru, and include the potato, which is said to be indigenous to Chili.

History.

1. On the death of Henry I. his daughter Maud should have succeeded, but Stephen of Blois usurped the throne. A war ensued between the rival parties, but eventually an arrangement was come to, by which Stephen was to keep the crown, but on his death it was to pass to Henry Plantagenet, son of Maud and Geoffrey, Count of Anjou. With Stephen the crown left the Norman line.

2. Henry VIII. was the first English Sovereign proclaimed King of Ireland. Previous to this time, the English King was content with the title of Lord Suzerain. Under the Feudal system the vassal swore fealty to his superior by placing his hands within those of his master and declaring, 'I become liege man of yours for life and limb, and earthly regard, and I will keep faith and loyalty to you for life, God help me.'

3. John Wilkes, member of Parliament for Aylesbury in 1763, was arrested for libelling the Grenville ministry. He was a man of bad character, but witty and agreeable, and his persecution made him a popular hero. Some years later he became still more famous as the subject of a struggle between the House of Commons and the freeholders of Middlesex, who maintained their right to return him as their representative,

although, having been expelled from the House for another political libel, he was—so the Commons by a stretch of power had resolved—incapable of being elected into that Parliament. In this struggle the Commons endeavoured not only to limit at their own arbitrary discretion the free election of the constituency, but they transferred its rights to themselves by seating Luttrel as member, although Wilkes had defeated him by an immense majority.

Composition.

THE BRITISH EMPIRE IS ONE ON WHICH THE SUN NEVER SETS.

As the Colonies and Dependencies of Britain are scattered over the whole globe, and not confined to any particular quarter of its surface, the common assertion that 'the sun never sets on the British Dominions' is strictly true. By referring to a map of the world, it may be easily seen that the subject of this essay is not a poetical fancy. Seeing that the earth revolves on its axis once in every 24 hours, it must pass over 15° of longitude every hour. Therefore by the time that the sun has been four hours risen on England, he will be rising to all places under the longitude of 60° west, viz. our West Indian possessions. Four hours later, after having risen on all the other parts of British America, he will be making his appearance on British Columbia. Three hours after he will be rising in New Zealand or to all places under long. 180° west. Two hours later he will be rising in Australia, three hours later in Calcutta, in another hour on Bombay, in other two hours on Aden, in one hour more on Cape Colony and Natal, and two hours after he will be rising on Britain again.

Euclid.

1. Prop. 48, Book I.
2. Prop. 9, Book II.

Rider.—If a straight line be bisected, *the sum of the squares on the two halves is the least possible;* for if the line be cut in any other point, the line will be cut unequally; and by Prop. 9, Book II. the sum of the squares on the two unequal parts is double of the square on half the line, and of the square on the line between the points of section, or in other words, the sum of the squares on the parts of a line cut unequally is always greater than the sum of the squares on the halves of the line, by double the square on the part between the middle of the line and the other point.

Algebra.

1. Let x=number of minutes from 4 o'clock.
Then $2x$= „ „ past 2 „
or $2x+x+45$ make up the 2 hours;
∴ the equation is $3x+45=120$ minutes,

$$3x=120-45,$$
$$3x=75,$$
$$x=25.$$

2. $$\left(\frac{x^2+a^2}{ax}\right)\left(\frac{y^2+b^2}{by}\right)\pm\left(\frac{x^2-a^2}{ax}\right)\left(\frac{y^2-b^2}{by}\right)$$
$$=\frac{x^2y^2+a^2y^2+b^2x^2+a^2b^2}{abxy}\pm\frac{x^2y^2-a^2y^2-b^2x^2+a^2b^2}{abxy}.$$
$$\text{Sum}=\frac{2(x^2y^2+a^2b^2)}{abxy}.$$

Difference $=\frac{2(a^2y^2+b^2x^2)}{abxy}$ or $-\frac{2(a^2y^2+b^2x^2)}{abxy}$ if 2d expression $>$ 1st.

3. (1) $x^2-\frac{131x}{33}=\frac{52}{33}.$

Completing square,
$$x^2-\frac{131x}{33}+\left(\frac{131}{66}\right)^2=\frac{6864+17161}{4356}=\frac{24025}{4356}.$$
Taking root,
$$x-\frac{131}{66}=\pm\frac{155}{66},$$
$$x=\frac{131}{66}\pm\frac{155}{66},$$
$$x=\frac{286}{66}\text{ and }-\frac{24}{66},$$
$$x=4\frac{1}{3}\text{ and }-\frac{4}{11}.$$

(2) (a) $\frac{2x-25}{3}-\frac{6-y}{7}=\frac{2(x-7)}{5}.$

L. C. M. of denominators $=5\times7\times3$.
$$70x-875-90+15y=42x-294,$$
$$70x-42x+15y=875+90-294,$$
$$28x+15y=671.$$

(b) Reducing to common denominators,
$$870-30y-72x+24=320-80y,$$
$$-72x-30y+80y=320-24-870,$$
$$-72x+50y=-574.$$
Dividing by -2,
$$36x-25y=287.$$
From (a) $140x+75y=3355$ (multiplying by 5).
„ (b) $108x-75y=861$ (multiplying by 3).

Adding, $248x=4216$
$x=17$. Ans.

Substituting 17 for x in first equation,
$$\frac{34-25}{3}-\frac{6-y}{7}=\frac{34-14}{5},$$
$$3-\frac{6-y}{7}=4,$$
$$21-6+y=28,$$
$$y=28+6-21,$$
$$y=13.\ \text{Ans.}$$
$$\therefore x=17 \text{ and } y=13.$$

Mensuration.

1. If x=one side in feet, then $\frac{7}{2}x$=other,
or $\frac{7}{2}x\times x$=area=975744.
$$7x^2=1951488,$$
$$x^2=278784,$$
$$x=\sqrt{278784}=528\text{ feet};$$
∴ the one side is 528 feet long,
the other „ $528\times3\frac{1}{2}=1848$ feet.

2. Area $=476\times476\times\cdot7854$, or

```
     476
     476
    ----
    2856
   3332
  1904
  ------
  226576
   ·7854
  ------
  906304
 1132880
1812608
1586032
-----------
177952·7904
```

Area = 177952·7904 square links.

Reducing to acres, etc. :—
Dividing by 100,000 square links, which = 1 acre, we obtain

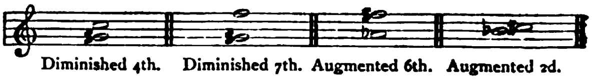
```
1·779528 acres nearly
       4
--------
3·118112 roods
      40
--------
4·72448 poles.
```

Area = 1 acre 3 roods 4·72 poles nearly.

Music.

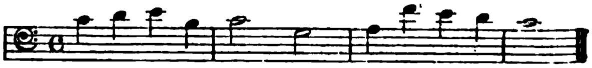
1.

2.



Diminished 4th. Diminished 7th. Augmented 6th. Augmented 2d.

3.



Publications Received.

Domestic Economy—
(1) Popular Lessons on Cookery. Griffith & Farran.

Drawing—
(1) Lewis's Perspective, Books 5 and 6. Walker & Co.

Examination Work—
(1) Pupil Teachers' Examination Papers for 1880. John Heywood.

French—
(1) Multum in Parvo French Verb Book. Simpkin & Co.

Geography—
(1) Statistical Atlas of England, Scotland, and Ireland. Part II. Educational. Edited by G. Phillips Bevan. W. & A. K. Johnston.
(2) Spence's Civil Service Geography. Crosby Lockwood & Co.
(3) Williams' Geography of the Oceans. Philip & Son.
(4) Types of Nations. W. & A. K. Johnston.
(5) Slate Paper Projection Atlas. Walker & Co.
(6) Slate Paper Outline Atlas. Walker & Co.
(7) Elements of Geography. Crosby Lockwood & Co.

German—
(1) German Phraseology. Crosby Lockwood & Co.
(2) German Prepositions. Crosby Lockwood & Co.

Grammar and Analysis—
(1) Heeley's Sentences for Analysis. W. & R. Chambers.

Kindergarten—
(1) Essays on the Kindergarten. Sonnenschein & Allen.

Latin—
(1) Creak's Dictionary of Cæsar's Gallic War. Hodder & Stoughton.

Music—
(1) The Old Notation Modulator, and how to use it. Pitman.
(2) Song, 'The Statesmen of England.' Pitman.
(3) Union School Singing Book. Gall & Inglis.
(4) First Lessons in Singing. Gall & Inglis.

Reading—
(1) Morrison's Literary Reader. Gall & Inglis.
(2) Morrison's First Geographical Reader. Gall & Inglis.
(3) Morrison's British Readers, Standards I. III. and VI. Gall & Inglis.
(4) Geographical Reader for Standard III. Stewart & Co.
(5) Geographical Reader for Standard III. W. & R. Chambers.

Science—
(1) Scientific Industries Explained. W. & A. K. Johnston.

School Management—
(1) Notes of Lessons for Infants' Classes. Jarrold & Sons.

Theology—
(1) First Epistle to the Corinthians, with Explanatory Notes. Philip & Son.

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Publications Reviewed.

A Complete Dictionary of Cæsar's Gallic War. By Albert Creak, M.A. Price 2s. 6d. London: Hodder & Stoughton.

We notice the fifth edition of Mr. Creak's method of supplying what he deems to be a want sorely and widely felt. For such books we confess we have very little sympathy. We presume that even Mr. Creak thinks it an advantage that beginners in Latin should learn the faculty of discrimination as well as the translation of words that in the whole course of their classical career they may meet twice or thrice only, and then, as probably as not, if this semi-key system is adopted, not recognise. Yet the chief merit that the book professes, is to save the student the trouble, and, we may add, deprive him of the benefit, of independent choice. He looks out his word; as probably as not, especially if the passage presents even the slightest difficulty, his overjoyed eyes meet the whole phrase translated. If he fails in doing this, he cannot go far wrong: there are but two or three pits to tumble into; if he takes his choice, and the first, the chances are two to one that he could have done no better. And thus somehow, by pit-flounderings never extensive, by guesses unfailingly happy, he reaches the end, and has 'gone through Cæsar' about as successfully as that memorable undergraduate who got through it with a gimlet. Of course, we know that Mr. Creak has on his side the great authority of Dr. White, but to our mind nothing has yet justified or can ever succeed in entirely clearing plans of this sort from the opprobrium which inevitably and deservedly attaches to keys. Never yet has there been, never in the future will there be, any great scholar who frames his learning on the principle of learning nothing about a word but its particular application. Of course there are some by whom this work will be hailed as a godsend, but they are chiefly confined to the superficial class of students, who imagine that the chief end of examinations is to escape being plucked.

Not even with the workmanship are we entirely satisfied. We seek a favourite catchword with examiners; we find 'Commeatus, n. 4, m (commeo),' etc. We track it up: 'Commeo, v. 1 (conmeo).' And there we must stop. In no place do we find a hint that *meo* and *eo* are not far different; *meo* is, of course, not mentioned as a separate head . No derivation is given for 'provincia;' yet we have known it asked several times, even from 'young learners.' If it is pleaded that this book is not intended for such information, we turn to the Druids: 'Two derivations are given, one from the Greek δρῦς, *an oak*; the other from the Celtic *der*, an oak, *wydd*, mistletoe, and *dyn*, a man.' Surely 'young learners' would be much more edified by knowing why the Great Bear should be called *Septentriones*, or that *castra* has a different meaning in the singular. This selective method leads to utterly false results at times; for instance, *provenio* is translated only by *yield*. Doubtless this is correct enough as far as Cæsar goes, but at the same time a far commoner meaning is *to prosper*, which is almost diametrically opposed to the meaning given. Only once, as far as our investigations have extended, is Mr. Creak positively faulty, and that is in the uses of *in*, under which head he gives translations which are not only misleading, but even at times quite mistaken.

At the same time, to students whose only object in reading Latin is to enjoy the commentaries, the book will prove eminently useful. The phrase lists and translation hints are very good, and in every case, we believe, modern names of places are given where they are known. Thus in a sense Mr. Creak may be said to have entirely succeeded in his attempt.

Sentences for Analysis for Use in Schools. Selected by J. H. Heeley, B.A. (Lond.). 32 pp. fcp. 8vo. Price 3d. London and Edinburgh: W. & R. Chambers.

We are glad to be able to give this book hearty praise. In a preliminary notice Mr. Heeley thus sets forth his aim:—

'Teachers have often found that the examples for analysis in the grammars are not sufficiently numerous, and are soon worked out. The following selection is intended to be placed in the hands of pupils, and its use in that way will prevent (1) the trouble to teachers of selecting sentences; (2) the errors of pupils in copying the given sentence; (3) the copying of one pupil from another, as each can do a different example.'

The selection, which includes poetry and prose from our best standard writers, shows excellent judgment. Pupil teachers, and indeed all who 'go in' for the University Local Examinations, will find these 'Sentences for Analysis' a valuable preparation for the work of the examination room.

Pupil Teachers' Examination Papers for 1880. By A. Park, F.R.G.S., etc. 196 pp. cr. 8vo. Price 2s. John Heywood.

Mr. Heywood the publisher, and Mr. Park the editor, are to be congratulated on the timely issue of this serviceable volume. No pupil teacher anxious to excel at his annual examination should be without these 'Papers,' and no head teacher desirous of economizing his time and familiarizing his assistants with the peculiar kind of questions set by the Education Department should fail to use them. Overworked teachers will know how to value the answers to Arithmetic, Algebra, Grammar, Euclid, and Mensuration.

The book is well and strongly bound, and costs but a florin.

Scientific Industries Explained. By A. Watt. 203 pp. cr. 8vo. Price 2s. 6d. London and Edinburgh: W. & A. K. Johnston.

When we opened this book a few evenings ago in the quiet of our little study, we fell into a reverie. We were carried back to the days—now, alas, far gone —when in the dimly-lit lecture hall of our Alma-mater we were, though ill in health, 'doing' our 'Certificate' papers. One of the questions in the school Management Section was on 'Candles.' Not having enjoyed the advantages of a close residence to a tallow-chandler's works, we knew but little about the manufacture of stearine, composite, paraffine, wax, and dip candles, so passed on to the next question. We should, however, have had full marks if we had read this book. Its object is 'to give an insight into the scientific industries of our country, in a simple and easily understood form;' and that object has been attained in a thoroughly interesting manner. Teachers in outlying districts, where strict economy has to be practised, will get much useful information from this volume, the recipes for making the various kinds of 'ink' being specially valuable. The book is readable, and discusses bleaching, dyeing, soap-making, paper-making, gunpowder, vinegar-making, electric-lighting, photography, fireworks, and numerous other 'industries.'

In the majority of well-conducted schools there is now a pupil teachers' reference library. We hope that when our readers are filling up their next order form, they will not forget *Watt's Scientific Industries Explained*, 2s. 6d. (Johnston). They will thank us for the reminder.

Johnston's Series of Maps of Ancient Geography: Maps to illustrate Cæsar De Bello Gallico. Mounted on rollers, 21s., with Handbook. London and Edinburgh: W. & A. K. Johnston.

We confess ourselves rather disappointed with this part of the above valuable series. Perhaps we expected too much, but at all events our anticipations are very far from being realised. The colouring is scarcely up to Messrs. Johnston's usual high standard of excellence, though the maps are clear and not encumbered with too many names. The intention is to illustrate Cæsar's *Commentaries*, which are now rising into such great popularity as means of elementary Latin instruction that they certainly need something more than a few scattered notes or a dictionary. The tribes mentioned are all duly inserted, and comically enough definite boundaries given to their territories. This latter piece of work is of course, from beginning to end, pure imagination, and should scarcely have been perpetrated without some caution to this effect, to young students who, unless warned, are apt to endeavour to fix in their memory, on the same level as the positions of well-known places, the amusingly wavy and wavering lines, by means of which the ancient geographer intends to represent where he supposes that one country may have ended and another begun. Under the same head comes our objection to the printing, which in a map is so important a factor, and has hitherto in Johnston's series been so admirably managed. More varieties of type should have been introduced. As it is, a hamlet like Carcaso stands on a level with Alesia, Narbo, and Lutetia. And creatures, who but for some unfortunate freak of chance would never have crept into history,—the Siburates, Crocosates, and Diablintes, for instance,— are distinguished from really powerful nations such as the Ædui, Arverni, or Helvetii, either by putting the letters of the same size farther apart, and thereby rendering them less distinguishable, or by making the inferiority and incapacity of a state vary directly with the blackness of the letters by which it is designated.

As to the geographical accuracy of the work, it is sufficient to state the name of its publishers, and add that in general the compiler seems to have followed a standard authority on such points, Dr. Heinrich Kiepert of Berlin. We note, however, one slight exception: Aquitania certainly includes the Pictones, Bituriges, Arverni, and Segusiani, the small district between the Garonne and Pyrenees being Aquitania Propria.

Notwithstanding these faults, Messrs. Johnston have supplied a great want. So far as we know, this wall map is the best yet issued, of this district.

It is accompanied by a handbook. We have space only for one or two suggestions, which, if adopted in future issues, would in our opinion render this small manual invaluable to all young students. We recommend, then, that Britain, the mention of which must always to us be the most interesting part of Cæsar's narrative, should occupy considerably more than half a page, and more particularly that the modern names of tribes, towns, etc., should be given in all cases where they are known. Who can doubt, for instance, that the position of the Parisii would be accurately known if it had been hinted that Paris takes its name from them?

If any detached notes, such as the one on 'suppli-

catio,' are deemed advisable, it would certainly be well to add to their number others on 'castra' and 'exercitus.' They would, so far as we see, bear quite as much on geography as does the present.

Arithmetic, Parts I. II. III., Integral, Fractional, Approximate. By A. Sonnenschein and H. A. Nesbitt, M.A. Price 5s. Sonnenschein & Allen, London.

We scarcely remember any book on Elementary Mathematics which has pleased us so much as the one now before us. The authors, one of them at least, are pupils of De Morgan, and his genius has left its stamp on every page. Even in the method by which children are taught to count, we have something showing originality. In italics we are told that to say 'two and two makes four' is a very ruinous process, and whether we agree to this axiom or not, every one will admit that our authors' method is very far more rational and infinitely more interesting than the humdrum monotony of that of so many schools of the present day. But there are other innovations even more important. The fickle and ever-changing boundary line between Arithmetic and Arithmetical Algebra is altogether and very rightly swept away. The learner feels at once that his symbols represent real things, that 3 is really something more than two twirls, two tails, and a projection in the middle, and has a definite meaning which in every operation it still keeps. Looked at in this light, there is no difference between the two sciences; *a* and 3 are both symbols in the same sense. We feel convinced that this work will ultimately do much to revolutionize the method of teaching Arithmetic. So far as we have examined it, the results are accurate, and we may state that *Stocks* are well and clearly treated, without making such a great gap as is usual between them and *Interest.* Abbreviations, even to the extent of 'casting out *elevens*,' are clearly and ably presented, though, as in the instance we mention, some may perhaps be dubiously shorter.

This book, we repeat, is a capital work, and cannot fail to be eminently useful.

A Student's Handbook of Psychology and Ethics. By F. Ryland, M.A. Price 2s. 6d. London: Sonnenschein & Allen.

Mr. Ryland's summary of Psychology and Ethics well deserves to become popular. It is designed for the London Examinations, but that by no means makes it an uninteresting catalogue of facts, nor does it in any degree detract from its general value. The author proposes to guide the student through the mazes in which this science, far more than any other, is involved, pointing out the best books, showing where each one is faulty, *summarizing* the important features, and thus presenting them in a form easy to retain in the memory, and especially convenient for reference. At least one-half of the work is taken up in analyses and quotations from Herbert Spencer, Stuart Mill, or Professor Bain, and by this means the student is provided with a pleasant introduction to the gigantic literature of the subject. If this book should reach another edition, and we hope that several will be called for, we think that a Physiological Glossary, which need not take more than a page, accompanied with diagrams of the organs of sensation, would be a vast improvement. More examination papers might be added; and we do not think it wise, in giving these as specimens, to quote selected questions only. If complete years had been given, any one could have seen at once that this book contained amply enough to satisfy the hardest requirements for the B.A. degree.

As for the subject-matter, we have very little comment to make; so much, indeed, does our author shine by reflected light, that very little is possible. In one place he quotes from Huxley's *Hume* an argument in defence of the Evolution of Mind. This is a resort of materialistic evolutionists which has been lately battered so much as rather to resemble a hovel than a refuge for any Christian psychologist who keeps his senses about him.

The science of Ethics is as well treated as that of Psychology; and so, without the slightest reservation, we have great pleasure in recommending this book. Mr. Ryland has done his work well.

Spence's Civil Service Geography. 144 pp. fcap. 8vo. 2s. 6d. Crosby Lockwood & Co.

We were familiar with this compact volume long before it was sent to us for review. For some time we had used it with satisfactory results. Our approval has evidently been shared by many others, for we notice the book has reached its *seventh* edition.

It is pre-eminently an Examination Geography, and contains within its pages as much well-arranged, accurate geographical information as any one needs for an examination of ordinary difficulty. A series of attractive maps and a carefully-prepared index enhance the value of the book. We have pleasure in commending it to our young pupil teachers in quest of a good, cheap, handy text-book.

Morrison's First British Reader.	6d.
„ **Third** „ „	1s.
„ **Sixth** „ „	2s. 6d.
„ **Literary Reader.**	1s. 3d.

London and Edinburgh: Gall & Inglis.

Had the wise man who penned the words, 'Of the making of books there is no end,' lived in our day, he might with reason have varied his remark and said, 'Of the making of *Reading* Books there is no end.' What, another new set! Yes, and a good one too.

It would be a pleasant duty to write a page on the merits of this excellent series, but we forbear, owing to the pressure on our space. To be brief, we have examined with care every reading book of recent date, and among the vast number there are none, judged from a practical teacher's point of view, we prefer to Morrison's 'British Readers.'

Wareham's Method of Teaching Sight-Singing by means of the Old Notation, Modulator, and Time-Tables. London: Pitman, 20 Paternoster Row.

The title of this book we have given in full as explanatory of the author's design. Teachers who are familiar with the modulator of the Tonic Sol-Fa system will be prepared for a perpendicular columnar arrangement, combining the most salient features of the diatonic and chromatic scales. By this the principles of modulation are illustrated, and useful occasional exercises given in *hitting*—as vocalists term it—*any distance*, or in other words, taking correctly any interval of the chromatic scale. When this scale should

be used by trained singers, and how far beginners, such as ordinary pupils of our elementary schools, should proceed before having to sing exercises from modulators, is open to discussion. Mr. Wareham's modulator, however, does not profess to combine the chromatic with the diatonic scale, but is simply a perpendicular arrangement of the enlarged black dots which form the body of crotchets and quavers in two columns on the ordinary treble and bass staves. In this a separate modulator has to be used for every key. The reading of the author's preface induced us to hope for great things. He speaks so confidently of his method from 'experience,' as to be certain that 'the whole system, with a thorough and practical knowledge of notation, may, with the devotion of one hour a week, be imparted to and acquired by children during the school age.'

We look with pardonable eagerness to Mr. Wareham's book to discover the details of a method capable of producing such remarkable results. What do we find? Nothing that we have particularly to complain of, but still less to justify such very large pretensions. We look at first to Mr. Wareham's modulator, and fail to see in the double columns of notes any remarkable features. The double columns are employed by the author for 'compactness,' and yet 'to avoid the too close, and therefore confused appearance a single column would present.' We can hardly understand this. We commonly understand compactness not being antagonistic to a close arrangement. But to us the dodging from one column to another would produce rather than avoid 'confusion.' This double column modulator can hardly be capable of producing such wonderful results. Nor can the preliminary exercise of the major scale, 'to be sung by ear without the modulator,' be thus credited. Nor can the singing of the common chord, together with the frequent repetition of the tonic, be the grand principle. In short, we fail to find any leading feature calculated to produce more than ordinary results. But while there is disappointment in the absence of peculiar excellences, there are serious defects in the unwise introduction of difficulties in the early stages of a course professedly intended for youthful scholars. Mr. Wareham adopts the nomenclature proposed to be applied to the present Italian syllables, in order to indicate the sharpening or flattening of intervals. This nomenclature is far from being settled, and, by its advocates among the Tonic Sol-Fa adherents is yet disputed, as appears in the last number of the *Tonic Sol-Fa Reporter*. Dr. Hullah's proposal to give a new name to the various intervals of the chromatic scale was, we fondly hoped, abandoned. But the complexities of naming chromatic intervals according to fancied changes of key is something to be dreaded, especially as being associated with systems professedly formed to *simplify* musical notation. This change of key, again, is by no means always easy to determine, nor settled by the changed prefix of initial letters. It seems far from settled whether harmony and the progression of other parts is to be ignored in settling key relationship. This, however, we do not urge against Mr. Wareham's method. All we complain of in regard to his book is that he thrusts forward this by no means easy matter of key relationship in the foreground for smoothing the path of young beginners. We may hereafter revert to this point, but proceed to notice some other matters that seem to be both vague and erroneous. Speaking of the tonic or key-note, Mr. Wareham regards the power of this note not owing to its melodious association with other notes, but by being itself strongly impressed upon the ear. 'Thoroughly impress,' he says, 'any note upon the ear, and all others will bear their proper relation to, and will circle round about it.' A drum resolutely beaten for some time and the prolonged tolling of a bell would certainly impress—we had almost said *din*—their respective monotones into the ear, but we never yet knew that they exercised any other influence upon the ear in regard to the scale, or 'caused other notes to circle round' the said monotone. Nor does the 'contrast' between the tonic and sub-tonic always exist so as to render the ear dissatisfied when it is not resolved upon—*i.e.*, does not ascend to the tonic. Take the following well-known example of one of Beethoven's most remarkable melodies :—

Here the leading note occurs three times in this beautiful strain, and in no instance ascends to the tonic. Many of these fanciful theories of key-relationship, the peculiar mental effect of certain tones in the scale, if not left to occupy debateable ground, should not be introduced into elementary lessons for children, especially in systems professedly aiming at simplifying musical notation.

We have alluded to the extensive nomenclature of intervals being a hindrance and not a help to correct music reading, and have to apply the same objection to Mr. Wareham's *Time Exercises*. These are correctly enough given, and form a succinct view of musical time notation. But after the pupil has mastered the respective values of minims, crotchets, and the rest, together with the leading modes of time and the corresponding signatures, he has by dint of hard practice to get the mechanical swing or movement of time into his head, so that every note may be associated with its relative length. All this is hard enough, simple though it may appear, and the difficulty consists in the mental effort involved in attending to two things at once, *i.e.* the mechanical clock-like progress of the time, together with the sign or form of the note. But Mr. Wareham adds another difficulty in the shape of a new time-name. He recommends the naming of the first beat *Tra*, the second *La*, the third *Ta*, and so on. This is a more objectionable hobby-horse than that of Dr. Hullah in his directions on beating time, given some forty years ago on introducing Wilhelm's system. Pupils were puzzled to remember, and annoyed when they forgot, whether the second beat was from left to right or from right to left. Need we say it was utterly needless for them to remember? The mechanical beat of the old singers by their feet on the floor or simple movement of the hands was all that was needful. The more simple these matters are kept the better. To attend to a multiplicity of names diverts the mind from its main business in music, *to attend to tone and time*. We have something to say against the exclusive attention to the synthetical plan of teaching music, and the ignoring of

the analytical. We are not sure whether children ought not to be allowed, encouraged, yea, taught to sing without always insisting that they should do this from musical notation. We do not prohibit children from speaking before they have learned to read, nor need we dread their singing before they know their notes and can read all the intervals of the chromatic scale from modulators. A class of boys was drilled in the *crotch, crotch, crotch* of Hullah's system in the heyday of its popularity. One of the committee of the school witnessed the lesson, and being possibly as tired as the boys were, went out of school with them at noon. As soon as the boys were free, they trotted merrily along the path singing not Do, Re, Mi, nor *crotch, crotch, crotch*, but to the Committee man's horror, a lively strain to the words 'Hey jim along, jim along Josey!' The master was duly informed of this depravity, but failing to see the enormity of the procedure, he, the master, gave the boys a vocal exercise founded on the strain of the song in question. The boys listened, became greatly interested, and entered into the exercise *con amore.* The singing was from that time a success. The boys soon understood the leading points of musical notation, and the lessons afterwards given from the best of well-known popular melodies were always most popular. In regard to time exercises, one useful plan is to set part of the class to sing by counting, while the others sing the music to the words. This may also be varied by the strains being simultaneously sol-fa'd while also sung to the words to which it is set. As, however, our object is not now to propound plans, but to examine those in the book before us, we refrain; and while commending the author for great ingenuity and earnestness, regret that he has attempted too much, and by the introduction of neeedless topics and unseasonable difficulties, added to rather than lessened the obstacles to the acquisition of music by young scholars.

Popular Lessons on Cookery. By a Former Staff Teacher of the National Training School of Cookery. 186 pp. fcp. 8vo. Price 1s. 6d. London: Griffith & Farran.

There are so many cookery books—good and otherwise—already in the market, that we must own to some feeling of suspicion when this new candidate for public favour was put into our hands. Upon examining the book, our confidence was, however, soon established, for the lady—we presume the work is not a gentleman's—who wrote it evidently knows her work well. In a short sensible preface she says: 'This book professes to be nothing more than a faithful transcript of demonstration lessons given in various parts of London, its suburbs, and the country.'

In a threefold sense it is popular—firstly, because the book is divided into two sections, the former being devoted to 'Plain,' and the latter to 'High Class' Cookery, thus rendering it valuable alike to rich and poor; secondly, because it is written in a terse simple style within the grasp of the unlettered; and thirdly, because it is cheap.

The ten lessons which form the 'Plain' Cookery sections are:—

1. Roasting, and puddings generally eaten with meat.
2. What to do with the cold meat.
3. Boiling meat, tripe, vegetables.
4. Soups and stews.
5. Frying and broiling.
6. Pies and puddings.
7. Cheap dishes.
8. Fish.
9. Bread and cakes.
10. Cookery for the sick and convalescent.

The remarks on 'What to do with the cold meat,' 'Cheap dishes,' and 'Baking bread,' are admirable.

We strongly recommend the work. It will make a cheap and excellent gift-book. Messrs. Griffith & Farran have sent it forth in a neat and attractive binding.

The Statistical Atlas of England, Scotland, and Ireland. Edited by G. Phillips Bevan, F.S.S., F.G.S., etc. Part II., Educational. Price 7s. 6d.

This publication furnishes an instance of an admirable idea admirably carried out. Almost every kind of educational statistics is here tabulated. The arrangement is perfect, and reflects the highest credit on Mr. Bevan, the editor.

Not a whit less praise is due to the publishers. The three maps of England, Scotland, and Ireland (on each of which appears a neat plan of the capital of the country) are excellent specimens of the lithographer's art. This valuable *résumé* of educational statistics deserves a wide circulation.

A Short and Easy Practical French Verb-Book. By A. Antoine. 40 pp. fcp. 8vo. Price 6d. London: Joseph Hughes. 1881.

M. Antoine has in this very neatly-bound manual of forty pages attempted to give a sufficient account of French verbs, 'the backbone of the language.' We are not altogether of the opinion that he has succeeded. The omissions are many, and in some places serious; the English often execrable, and the French by no means perfect. We first have the conjugation of *avoir* and *être* in full, then regular verbs are considered, and remarks usually sensible, but *never complete*, are made on various irregularities, such as verbs in *-eler*, *-eter*. Thus far the book is well-nigh perfect, except that we should have preferred to see *béni*, *bénit* with their accents. Then it is that we are plunged headlong into confusion. The irregular verbs are jumbled together with scarcely a sign of order, except a poor pretence at classification which will sometimes lead the learner into great mistakes. For instance, *taire* and *plaire* are given together, whereas the past participle of *taire* is *tû*, that of *plaire*, *plu.* Circumflex accents M. Antoine has been extremely careless about. They seem to be quite at a discount with him. Even with a cursory inspection we find *éclot*, *éclora*, *écloront*, *écloraient*, *mu*, etc. Throughout we detect what must either be culpable neglect or superb scorn for small points. *Echoir* is impersonal through its very meaning, and yet we find *J'échus* given. We defy M. Antoine to give us the meaning of 'I fall due.'

We might pick many other holes in this work. A rule far too broad is given for distinguishing *croître* and *croire*. We have detected four mistakes in the list of verbs which follow *conduire*. Other parts are finished in a similarly slovenly fashion. But we have said enough surely to convince even the author that the

book is not perfect. Had a tabular form been adopted for the irregular verbs, fully annotated where necessary, its compass would have been considerably less than thirty pages, and it would have been proportionately more valuable.

We would recommend also more attention to details, and finally remind the author that it is possible to know French far too well to be able to write a book on French Grammar, especially if the difference between the idioms of the two languages has not been fully grasped.

Engagements for April.

April 1. Philological Society, 'Parts of Speech,' etc., H. Sweet, M.A.; and 'Lowland Scotch Place Names,' Walter Brown, M.A., . 8 p.m.
Royal Institution, 'The King in his Relation to Early Civil Justice,' . . . 8 p.m.
Carlyle Club (Bridge House Hotel), . . 8 p.m.

4. Victoria Institute, 'The Visible Universe.' Professor Balfour Stewart, F.R.S., . 8 p.m.
Medical Society, ... 8.30 ,,

5. Society of Arts, 'Trade Relations between Great Britain and her Dependencies.' William Westgarth, ... 8 p.m.
Teachers' Investment Society.

6. Geological Society, ... 8 p.m.
Ascham Society, 'Spelling Reform.' J. Fenton, Esq., ... 8.30 ,,
Dialectical Society, 'Crimes and Punishments.' H. Nillosby, Esq., . . 8 p.m.

7. Society of Arts, Applied Chemistry and Physics Section, ... 8 p.m.
Archæological Institute, ... 4 p.m.
Linnean Society, ... 8 p.m.

8. Royal Institution, 'Conversion of Radiant Heat into Sound.' Professor Tyndall, D.C.L., F.R.S., M.R.I., . . . 8 p.m.
Royal Astronomical Society, . . 8 p.m.
New Shakspere Society, I. 'Shakspere's Old Men,' Miss Constance O'Brien; II. 'Was Shakspere a Democrat?' Miss Emma Phipson, ... 8 p.m.

11. Geographical Society, ... 8.30 ,,
Candidates' Examination at South Kensington. (Apply on Form 325 before April 15.)
Medical Society, ... 8.30 ,,

12. Anthropological Institute, . . . 8 p.m.

14. Last Day for Science and Art, Form 325.

18. London, Conference of N.U.E.T.

21. Linnean Society, ... 8 p.m.

22. Ascham Society, 'Science Culture for the Young.' D. Andrew Wilson, F.R.S.E., . 8.30 ,,

25. St. Mark's College Anniversary.
Medical Society, ... 8.30 ,,

26. Anthropological Society, . . . 8 p.m.

27. Geological Society, ... 8 p.m.
Annual Meeting of London Institution.

29. Society of Arts, Indian Section, . . 8 p.m.

Monthly Notes.

Education in Parliament.—The present state of things is not favourable to the bestowment of much consideration on Educational matters in Parliament. There are at the present time three Bills dealing with such matters which have passed the first reading in the House of Commons. One, The Education Endowments (Scotland) Bill, is a Government measure. It is substantially identical with that introduced last session under the same title. The only difference relates to certain provisions contained in the former with regard to Heriot's Hospital, which met with such vigorous opposition from the governors of that body, and from the inhabitants of Edinburgh generally, that they had to be withdrawn. The main object of the measure is to secure the more efficient employment of educational endowments for the purposes of secondary education in that portion of the United Kingdom. This being a Government measure, and being approved of by the Scotch members generally, it is possible that it may pass during the present session. Another Bill is that introduced by Sir John Lubbock, The Teachers' Registration Bill. Should an opportunity be secured to propose its second reading, it will receive the determined opposition of the National Union of Elementary Teachers, on account of its non-inclusion of certified elementary teachers in the register which it proposes to establish. The third Bill is one entitled, The Free Education (Scotland) Bill, and is introduced by Dr. Cameron, one of the members for the city of Glasgow. It is down for the second reading on the 18th of May. Whether that day will bring the opportunity remains to be seen. As to the fate which such a Bill will receive at the hands of the present Parliament, there is no room for doubt. In consequence of what may be called the provisional character of the Education Code for the present year, it has been allowed to pass without challenge. The proposed educational grant for the year ending March 31, 1882, is £2,683,058, being an increase of £178,998 over the rate of last year. The estimated average attendance at elementary schools in England and Wales is very nearly 3,000,000. For these the portion of the grant provided is £2,362,142. The rest of the vote is apportioned to education in Scotland, to Science and Art, to inspection and other working expenses of the Department. Several notices have been given of motions to be proposed on the introduction of the Education Estimates. One of these is by Colonel Barne, to the effect that a larger proportion of the expense of elementary schools should be defrayed from the Imperial Exchequer. Attention is to be called, too, by Mr. Meldon, we believe, to a recent circular issued by the Education Commissioners in Ireland with respect to the teaching of agriculture in elementary schools in the rural districts. The teachers complain that it is unjust that those of them who are themselves without agricultural training should not only be required to teach agriculture, but should be subjected to deductions from their ordinary and result fees on account of their pupils failing to pass in this subject. The Education Estimates have not come on at the time of writing, but there is no difficulty in anticipating the fate of Colonel Barne's motion at least.

The Senate of the Irish University has just completed a scheme of that Institution which will also need to be submitted to the consideration of Parliament when opportunity offers. According to the *Times*, the Senate has, in the main, taken as its model the existing Queen's University which the new University is to supersede. The principal innovation proposed is the admission of women to degrees on equal terms with the other sex, a separate time

for examination being appointed. The machinery cannot, however, be put in motion without a grant of money, and so this, too, must remain *in statu quo* until Parliament can afford time to attend to such matters. In a similar position is the Report of the Commission on Intermediate and Higher Education in Wales, and the recommendations which that Commission may see meet to submit. Mr. Mundella, in reply to a question by Sir Robert Cunliffe, one of the Welsh members, has stated that he was afraid that he could not hold out the hope that these could be considered by the House during the present session.

THE SCHOOL BOARD FOR LONDON.—The subjects which have chiefly occupied the attention of the School Board for London during the past weeks, besides its routine business, have been Corporal Punishment, and the Eligibility of Women as School Inspectors. The former subject was introduced by Mr. Heller, who proposed that the present rule of the Board, which permits corporal punishment to be inflicted only after school hours, should be repealed, and that on this point teachers should be left to their own discretion. The previous question was moved by Miss Helen Taylor, and after a very full and sometimes warm discussion, this was adopted by 21 against 15.

The other question was introduced in connection with a resolution of the Board to appoint an additional (a seventh) Inspector of its schools. The motion that in the advertisement for candidates it be stated that a woman is eligible, ultimately proposed by the School Management Committee, to whom the question had been referred, was carried—only by the casting vote of the chairman, however, 20 voting for and 20 against. The Hon. Lyulph Stanley, M.P., has given notice that he will move to rescind the motion carried by the casting vote of the chairman. A very elaborate and carefully-prepared Report has been produced by the Endowments Committee of the Board concerning the Charity Endowments in possession of the Guilds of the City of London. One of the conclusions of the Committee is that of these funds upwards of £100,000 per annum ought fairly to be available for the purposes of education.

THE NATIONAL UNION OF ELEMENTARY TEACHERS.—The Executive of this body is busy preparing for its annual conference, which is held this year in London, during Easter week as usual.

It has resolved to endeavour to induce some eminent educationalists outside of the Union to read papers on the following three subjects:—(1) Sir John Lubbock's Bill on Registration; (2) The Past and Future Policy of the Union; and (3) Charter of Incorporation for the National Union of Elementary Teachers. Mr. Matthew Arnold, Sir John Lubbock, M.P., and Sir U. Kay Shuttleworth have been requested to write papers on one or other of these subjects. An advanced party is being or has been formed in connection with the National Union of Elementary Teachers. The members of this party avow their belief that the Union moves too slowly towards the attainment of its objects. They declare themselves thoroughly loyal to the Union, and instead of quitting it because they think it does not accomplish enough, they are determined to do what in them lies to make it accomplish more. With this object in view a provisional Committee drew up the following draft programme:—

1. To strengthen the Union and promote the more rapid attainment of its objects by—
   (*a*) Increased subscription.
   (*b*) Restriction of membership to those who are or have been teachers in public elementary schools.
   (*c*) Open reporting of Executive meetings.
   (*d*) Reform in the mode of election of and representation on the Executive.
   (*e*) Efficient control of Local Associations by the Executive.
   (*f*) Making the office staff efficient.
2. To raise education.
3. To regulate the supply of teachers.
4. To improve the mode of certifying teachers.
5. To obtain Parliamentary representation.
6. To instruct the public on educational matters.
7. To resist oppression.

This programme was duly considered, discussed, and unanimously adopted at a general gathering of those members of the Union who are favourable to the formation of an advanced party, which met on the 19th March.

THE EDUCATIONAL CLAIMS OF WOMEN.—A congregation was held at Cambridge University on the 24th of February, for the purpose of presenting and voting upon the Report of the Syndicate, which recommended the admission to the 'Previous' and Tripos Examinations of all female students who had fulfilled the conditions as to the length of residence and standing required of the male members of the University, the residence to be either at Girton or Newnham College, or within the precincts of the University under the regulations of one of the Colleges. Grace No. 1, adopting the principle of this Report, was carried by a majority of 398 against 32. Paragraph 8 in the Report, which proposed 'that in each class of female students in which the names are arranged in the order of merit, the place which each of such students would have occupied in the corresponding class of members of the University shall be indicated,' was adopted by a like majority; and all opposition to further portions of the Report was abandoned as hopeless. This success is said to have surpassed the most sanguine anticipations of the ladies and the supporters of their claims.

THE GOFFIN CASE.—This case reached what will probably be its final stage on February the 25th, when judgment was given against Mr. Goffin, the plaintiff, in the High Court of Justice, Queen's Bench Division. The origin of the case was a charge by Col. Donnelly, of the Science Department, against Mr. Goffin, who is head master of the United Westminster Schools, of having improperly obtained, beforehand, knowledge of the Chemistry questions, and of using that knowledge in preparing his pupils for examination. In consequence of this charge the Science and Art Department suspended Mr. Goffin's certificates, and intimated to the governors of the school that no more grants would be given for pupils instructed by Mr. Goffin. The governors carefully examined the facts of the case, and unanimously decided that Mr. Goffin was innocent, and determined to maintain him in his position as head master of the Westminster United Schools. Subsequently, chiefly through the efforts of the National Union of Elementary Teachers, a Select Committee of the House of Commons was appointed to investigate the facts of the case. This Committee

decided in favour of the Department, and drafted a report very adverse to Mr. Goffin. At this stage some of the parents of Mr. Goffin's pupils took up the case. They criticised with severity the constitution of the Select Committee, and pointed out that, though the Department was one of the parties in the case, yet the Vice-President not only nominated the members of the Select Committee, but himself sat as one of its members, and took the leading part in its proceedings. They also directed attention to the facts, that Mr. Goffin, though the accused, was not allowed to defend himself, and was only permitted to give evidence as a matter of favour; that the witnesses were not cross-examined; that the evidence was given in Mr. Goffin's absence; and that no rebutting evidence was allowed. The governors took the same view of the matter, and again decided that they could not in justice dismiss Mr. Goffin from his position as head master. They and Mr. Goffin's supporters maintained that, if the Department had sufficient evidence to justify their decision and that of the Select Committee, they should prosecute Mr. Goffin in a court of justice on a criminal charge. They refused to do this, or to take any action which might facilitate the procuring of a legal decision on the merits of the case. They suggested, however, that if Mr. Goffin were not satisfied, he might proceed against any of the witnesses for perjury. Hereupon the present action was begun. Mr. Goffin sought to proceed against Col. Donnelly for defamation. The defendant pleaded privilege, that no action could be brought against him for what he said in the capacity of a witness before a Committee of the House of Commons. Mr. Justice Field and Mr. Justice Manisty have decided that this plea is valid in law. And here we suppose the matter must end. Mr. Justice Field, in giving his decision, said: 'It is a bad thing, and a hard thing upon a private individual, that any body should be at liberty, anywhere, to say or impute to him by writing, or by word of mouth, things tending to his disparagement, or to his having committed a crime. And the law protects, *as far as it possibly can*, this right to the person so injured, to call upon his accusers to justify, by proving the truth of what he has said. But then, that interest, which is a very great and a very considerable one, is governed by a still greater interest. The greater interest is the necessary administration of law.' Of course, the principles involved in this case are of universal application, and of interest to all classes of the community. The case has, however, a special interest for teachers, not only because of its immediate bearing on the position of one member of the profession, but also because of the special relations which all teachers sustain towards the Education Department, and the consequent probability that any one of them may find himself, any day, in a position similar to that in which Mr. Goffin has been placed.

UNIVERSITY COLLEGE, LONDON.—The opening of new buildings in extension of this Institution was celebrated by a dinner on the 16th of February. A large number of eminent scholars and educationists were present. Earl Kimberley occupied the chair. The speakers, besides the chairman, were Lord Sherbrooke, Professors Tyndall, Morley, and Max Müller, Sir John Lubbock, M.P., and Sir F. Leighton. Lord Sherbrooke spoke of the tendency manifest at the present time to increase the quantity of instruction attempted to be imparted beyond the capacity of pupils to receive. His Lordship expressed the conviction, that in consequence of this the information acquired was often inexact, superficial, and useless, and strongly advised pupils and students to make a choice of subjects and see that what they did was well done.

OWENS COLLEGE, MANCHESTER.—The people of the north are showing characteristic public spirit and enterprise in connection with the new Victoria University and its affiliated Institutions. At a recent meeting of the Court of Governors of Owens College, plans were submitted for the extensions, which will cost about £40,000 to erect. It was unanimously resolved to proceed with these extensions, and a committee was appointed to carry out this resolution.

CITY AND GUILDS TECHNICAL INSTITUTE.—The annual meeting of this institution was held on Monday the 14th March—Sir S. H. Waterlow, treasurer, presiding. In a lengthened report which was presented, an account was given of the building which is to be erected at Kensington for the accommodation of the Institute, the estimated cost of which, including apparatus and furniture, is £76,000. Towards this sum £55,000 have been secured. Meanwhile the Council have empowered the executive committee to make arrangements for the erection forthwith of so much of the building as can be completed for this sum. During the past year 422 students have received instruction in physics and applied chemistry at the temporary class-rooms in Cowper Street, and 721 tickets have been sold at fees varying from 2s. 6d. to 7s. 6d. Arrangements have been made for extending the operations of the Institute to meet the increasing demand for instruction on the part of artisans both in the City and in South London. The Council state that no part of the Institute's operations has been more successful than that connected with the technological examinations. The total expenses of the Institute from February to December 1880 were £9473, 5s. 8d. The income for the year 1881 will be not less than £18,515.

IMPORTANT NOTICE.

As young students, especially those who read without a coach, frequently encounter difficulties in their studies, the Editor is pleased to announce that in future numbers of this journal there will be a 'Query' column. Any subscriber who has *bonâ fide* failed to solve a problem or question may have help *free of charge*. All communications for the 'Query' column must reach the office not later than the 15th of the month.

As many of our readers attend the May examinations of the Science and Art Department, the Editor is pleased to announce that in the next issue of this journal (published on April 27th) the questions set at the last examination in Stages I. and II. of Mathematics will be printed, with model answers to every question.

Mr. Theodore Wood's first article on 'Practical Lessons on Insect Life' will also appear in our next issue.

THE

Practical Teacher

A MONTHLY EDUCATIONAL JOURNAL

Edited by JOSEPH HUGHES

'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

VOL. I. No. 3. MAY 1881. Price 6d. Post Free, 7½d.

Health at School.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),
President of the Council of the British Medical Association.

No. II.—SITE (*continued*).

THE floor of a schoolroom should always be raised above the level of the ground, and a free ventilation provided beneath it, so that no manufactory of morbid products should be possible. There should be no openings in the floor, through which unsuspected depots of sweepings may collect, so as to form a considerable heap of disease-producing touchwood, only requiring in the course of time a germ of morbid matter to fall upon it to enable it quickly to grow a quantity of infective material. The chinks in school floors are possible sources of danger which must be prohibited. A dry area should be constructed around the outside walls with which the sewers should by no chance be able to communicate. This area should extend below the level of the basement, and be carefully ventilated. I have seen sewage conveyed through these areas; in earthenware pipes, a settlement has taken place on one side of the area; the change in level has broken the pipes and allowed the discharge of sewage into the area. This discharge went on for some time, and was not discovered until all the people of the house were laid up with typhoid fever. In another case in which an iron pipe was used for the purpose, the iron had oxidised at the point of junction with the outer wall, and sewage was discharged into the area. It went on for years quite unsuspected. There was a disagreeable smell in a library fifty yards away from the place of exit, which no efforts of the architect could remove until the hole in the pipe was discovered by accident. Much illness had been produced in that house for many years in consequence of this apparently unimportant defect.

It is right to remove from within the foundations all the subsoil which contains organic matter, excavating it until the virgin earth is reached.

If the latter is itself impure, as is the case in some deltas and other more recent formations, it should be removed for a certain depth; then, when convenient, covered over with chalk, and above the chalk several inches of concrete should be placed. If it be in a district in which the ground-water must sometimes rise and fall, it should be roughly asphalted, so as to reduce the evil to a minimum. The lime in the composition of concrete is of some service, for so long as it remains as an oxide it absorbs a certain quantity of the carbon anhydride (CO_2) which may happen to penetrate it. Of course the greatest care must be taken to prevent the possibility of sewage pollution. This is one of the greatest dangers to which the fabrics of school buildings are exposed. It is not at all uncommon to find the subsoil polluted by these occasional discharges. Sites upon clay formations should be avoided where possible. If the geological formation is one of clay only, of course it cannot be helped; but if there is a choice, it will be found that the bed of clay is some degrees colder than a more porous subsoil. There is one advantage in clay—viz., it is not so liable to soakage from sewage; but this is fully counterbalanced by its disadvantages.

If it is proposed to place a school upon the side of a hill, the site must be carefully examined: bogs are found there as well as lower down, and any position which may cover an underground stream is bad. The foot of a slope or the bottom of a narrow valley is not good. If the side of a hill is chosen, care must be taken to provide that the buildings are kept perfectly clear of ground at a higher level. They should be raised so that the surface slopes downwards from the school-house towards the rising ground. The soil should never rise immediately upwards from the building so as to allow superficial drainage or soakage to take place towards the foundations. There should be room for the free play of air on all sides. The slope of a hill which rises abruptly, and which affects more than one side of the house, or a cliff coming close to the buildings, should be avoided, even if the site can be had for nothing. The top of a hill may be a disadvantage if it be so placed as to be exposed to the influence of malaria from distant marshes, or to the smoke and used-up air of some great town immediately below.

But high and bleak sites are better than low ones, when as regards the latter there are other things which are to their disadvantage. The neighbourhood of ground which is covered with rank vegetation is to be avoided; it indicates an impure subsoil. Sites which are sometimes obtained by filling up some old swamp or venerable pond are not satisfactory places for school-houses. It is probable that the conformation of the neighbouring strata tends to bring water in those directions, and to keep it there.

It is not good to have school-houses immediately and closely surrounded by trees, although a few trees in exposed situations, when kept away from the buildings, are highly advantageous. Everything which tends to allow of stagnation of air in and around the school is to be avoided; for this reason, high walls and other lofty buildings are to be kept as far from the grounds as possible. It is seen sometimes that at a given spot on cold evenings a fog first appears in a given neighbourhood: that spot is one to be avoided. The bottom of a narrow valley is quite sure now and then to be invaded by an underground stream of water, and is not therefore a satisfactory site.

If there are trees, they should be to the north or east, and sufficiently removed to prevent them from acting as impediments to ventilation. Air and light are most important factors in the case, and nothing should be allowed to interfere with a due proportion of both being attainable on all sides of the buildings. In great cities it is not always possible to have trees in the playground; they are advantages when kept immediately away from the school-house. Light and shade are necessary parts of school life, and there are times even in this country when it is beneficial to have the direct rays of the sun tempered by the pleasant green of healthy foliage—they diminish evaporation from the soil beneath. The summer temperature is lower, and the cold of winter less in districts in which trees abound, than in those places where there are none; decaying vegetation is not, however, to be encouraged near to a school-house.

The building should be placed so as to obtain all the light possible. The prevailing winds should be considered, and the point made out from whence the largest amount of rain comes. The roof should be planned so that it shall carry off the water as quickly as possible, and as not allow it to be blown upon the side walls, thus rendering them perpetually damp. It may be necessary in rainy districts to have those parts of the school which are not continually occupied on that side of the building from whence the most rain comes. This, however, only applies to the rainy districts of the country. Every precaution should be taken to get rid of the rainfall, so that it shall not saturate the subsoil. To build a school-house without spouting sufficient for the purpose is bad. Every precaution should be taken to keep the buildings dry; the architect, as regards these arrangements, should be called upon to provide for the maximum rainfall on any day in the year, and not for an average only. It is the wettest seasons which test the work both of spouting and drainage, and in both cases it is the maximum fall or flow which is to be met, and not the average. It is the maximum which brings disaster when it is not provided for. The ill-health of a whole district may be an established fact, because a given school has been inundated by an unusually heavy thunderstorm, in consequence of defective spouting and drainage. The position, as to the points of the compass, which the schools should occupy has also to be considered. The buildings ought so to be placed that every room should receive the direct rays of the sun during some part of the day. Verandahs are better avoided, and no architectural ideas of beauty should be allowed to introduce them if they impede direct sunlight. Exclusively northern windows are only to be admitted when required for ventilating purposes. To effect these objects, it is better for the school to be so erected that its corners are towards the points of the compass, rather than as churches are usually built, on its direct lines. It may be that the ground beneath the school floor has to be utilized as a playground; it is a bad arrangement, and should only be allowed when it is quite impossible to obtain further room for the purpose in proximity to the school. This point will be considered in detail when the subject of Bodily Exercise is considered.

No. III.—DRAINAGE.

A site without means for drainage must be declined at any price. There should always be a fall from the school-house capable of being utilized for drainage, and this fall should be adequate for the purpose of conveying it away. It should be more considerable for a small school than is absolutely required in the case of a larger one, and the smaller the rainfall of a given district the larger the fall should be; and it should never be less than 1 in 50. If there is a system of sewers into which the drains from the school are to discharge, there should be a man-hole at the junction with the main sewer, and the junction so arranged as to be capable of inspection without having to disturb the drain pipe. The junction with the sewer should never be at a right angle, but slanting in the direction of the stream of sewage. Stoneware or earthenware syphons are now manufactured to cut off all direct communication between the public sewer and the private house drain, which are good, provided they are examined occasionally; but if such a one is used, it ought to be provided with a ventilator between the syphon and the school-house, and be placed close to the trap of the syphon. The London Sanitary Company provide these. Stiff's interceptor is something of the same kind, and so is Pott's Edinburgh chambered sewer trap, and several other makers have traps which are equally efficacious, but all require occasional inspection. Impervious pipes are better than bricks for sewer purposes.

It should be an established rule that no sewer pipe should be allowed to penetrate within the main walls of any school building on any pretence whatever. There should be a most perfect interception; the sewer should carry off the sewage by means of communications which should be indirect only. Sewers are necessary evils in large towns and among great congregations of people. They have their dangers. It is not necessary to admit them within the precincts of the building, and if kept outside it is certain that they cannot act as channels for the conveyance of mischief when unsuspected. All premises, therefore, which have direct communication with the sewer should be *in annexes*, and kept outside the main walls. It may be convenient for the school staff to have W.C.'s close at hand, but the convenience is

small compared with the danger. The danger is small when they are properly constructed outside the building; it is enormous if they are brought within the fabric itself.

It should be an established rule, that all sewers should be laid on concrete in those parts of the curtilage of the school-house which are school property. This bed of concrete should be constructed before the sewer is laid down. It should be made according to the provided fall, and when once fairly laid, will for ever prevent that particular sewer getting displaced, except by extraordinary circumstances. Well-laid sewers may be the means of saving a great annual expense, as well as preventing evils which will sooner or later follow when they are badly laid.

The custom of the district will determine whether the rain-water from the roof goes into the sewer or not. It is a bad custom to thus send away a valuable commodity, but rain-water butts, as too often placed, produce mischief, from the dampness which surround them. The rain-water should be conducted into the nearest water-course, unless it be stored in properly-constructed receptacles. It is a bad custom to allow the rain-water gutters to communicate with the sewer; and when the stack pipes discharge themselves into the ordinary house drain, the pipe should be trapped at its junction with the sewer, so that no foul air shall find its way beneath the eaves of the school, and then be conveyed into the nearest open window.

Anecdotal Natural History.

No. III.—BATS.

BY REV. J. G. WOOD, M.A., F.L.S.,
Author of 'Homes without Hands,' 'Nature's Teachings,' etc.,
AND THEODORE WOOD, M.E.S.,
Joint-Author of 'The Field Naturalist's Handbook.'

IN almost every temperate part of the world, but more especially abounding in tropical climates, are found the curious creatures which are popularly known as bats, and scientifically as *cheiroptera,* an appropriate word signifying 'hand-winged' animals. Australia, however, must be excepted, as the whole of the Australian mammalia belong to the Marsupials.

It is only of late years that their proper position in the scale of creation has been discovered. Before that time, some of the wildest conjectures were made on the subject. As the creatures possessed the power of flight, some authors placed them among the birds, entirely overlooking the differences in structure, which should at once have pointed out their place among the mammals. Some, considering them to be quadrupeds, because they were able to walk upon the ground, though after a rather clumsy fashion, imagined that they must form a connecting link between the mammals and the birds; and it was not until later discoverers carefully investigated their anatomy that the real place of the bats was arrived at, namely, just after the monkey tribe, and before the cats.

The appearance of the bat is familiar to almost all, the strange membranous wings, enabling their owner to pursue their aerial evolutions with an ease and rapidity not exceeded by any bird, being the first points which arrest the attention.

Though possessing an almost equal power of flight with the birds, the wings of the bat are by no means constructed upon the same principle. Instead of feathers, the wing is composed merely of a membrane tightly stretched between the bones of the fingers, and extending along the sides as far as the tail. In order to fully understand this structure, we must examine the modifications of the skeleton which render it possible.

In the first place, the framework of the wing of the bat is formed merely by the bones of the arm and hand, which, more especially those farthest from the body, are elongated to a wonderful extent, the middle finger being actually of greater length than the whole head and body of the animal. The only exception is the thumb, which is very short, and armed with a strong curved claw.

Not only are the bones of the fingers elongated, but those of the palm of the hand, or 'metacarpals,' are drawn out to an astonishing length, that of the thumb being excepted, as above mentioned.

If we spread our own fingers widely, we shall see that their bases are connected by a fold of skin which is hardly perceptible when the hand is closed. Now and then, it is extended as far as the first joint, and there are many of the mammalia in which it is still further developed. The seals which fly through the water have the hand membrane greatly extended, and other water-living mammalia have it developed in a lesser degree.

Then, the flattened skin-fold of the flanks is not peculiar to the bat tribe. It can be traced in the common squirrel, and in the flying lemus, flying squirrels, and flying opossums a similar structure is seen.

In the lower part of the arm, that from the elbow to the wrist, there is practically one bone only, instead of two, as is usually the case, the reason of which is very apparent. It is owing to the two bones of the arm that we are enabled to turn the limb inwards and outwards at the elbow. If the bat were possessed of the same power, it would be impossible for the wing to strike the air with the steady beat necessary to flight, for the resistance of the air, turning the arm sideways, would allow the wing to cleave through it sideways, and the power of the stroke would thus be of no avail. As it is, however, there is one bone only, the bat is unable to turn the limb, which therefore always presents its full surface to the air.

The bones of the hand, too, cannot be clenched as in a fist, but possess a side motion only, enabling the wing, when not in use, to be folded closely against the body.

The membrane which forms the wing is merely a prolongation of the skin of the flanks and other parts of the body, stretched tightly between the finger-bones, and extending as far as or farther than the tail, which, in the insect-eating species, is included in it, serving, like the tails of birds, as a natural rudder by which the animal can direct its course. In the fruit-eating bats, however, where so great agility in the air is not necessary, the tail is left partly or entirely free, and is much used in climbing and walking.

The membrane is a double one, very thick in those parts contiguous to the body, but so delicate near the edges, that by the aid of a microscope the blood corpuscles can be seen passing along the vessels that supply the wing.

Though the powers of flight of the British bat are fully equal to those of many birds, they have never been known to migrate from one country to another, and it is very doubtful whether they possess the ability. For bats have none of the large auxiliary air-cells found in birds, acting as a sort of reservoir, and their bones are not permeated with air-cells as are those of the feathered migrant.

There are, however, several bats belonging to the genus *Mycteris*, found in Africa, which possess a somewhat similar apparatus, though not constructed upon quite the same principles.

Great Bat, wing closed and open.

The skin is very loosely fastened to the body, a few membranous threads being the only bonds. The space between this loose skin and the body is utilized as an air reservoir, and is filled as follows. At the bottom of the cheek-pouches on either side is found a small opening, which can be closed at the will of the animal, and the air prevented from escaping. When the bat wishes to inflate its body, it closes the mouth, and forces the air from the lungs through the cheek-passages into the vacant space. To such an extent does it inflate itself, that it loses all resemblance to a bat, and looks merely like a round ball of fur provided with head and limbs.

The objects of this curious structure are not known, besides the evident one of increasing the buoyancy of the animal.

The shoulder-blades of the bat are enormously large, almost covering the whole of the ribs. These also are large and strong, and the breast-bone, besides being of unusual length, is furnished with a central ridge, or keel, like that of birds, for the better attachment of the powerful muscles which work the wings. The rest of the skeleton is of the very slightest description, in order that no unnecessary weight shall hamper the movements.

The feet are very small in proportion to the rest of the body, and are furnished with long curved claws, which are of assistance in walking, but are chiefly used in assuming the extraordinary position of rest, when the bat hangs head downwards, from some convenient ledge or beam, merely hooking itself on by means of the claws. In this strange and, one would think, extremely uncomfortable attitude the bat always rests, and passes the winter in a torpid condition.

Keeled Breast-bone of Bat.

It was remarked many years ago, that the bat possessed a most wonderful power of avoiding any obstacles that presented themselves in its path, and that it could pass among the branches of trees, even where the twigs were thickest, without coming in contact with them. In order to ascertain whether this was always the case, a number of strings were stretched in a darkened place, and several bats let loose among them; yet it was found that the animals avoided them with the greatest ease. Thinking that this power might be the result of an unusually keen eyesight, one investigator, named Spallanzani, in a very cruel experiment, put out the eyes of a bat, and again let it fly, but was surprised to see that the creature avoided the objects exactly as before. It was then thought for many years that the bat possessed a sixth sense unknown to man, and it was not until comparatively lately that the true secret was discovered.

A careful examination of the membranes of the wings and ears showed that they were intersected by exceedingly delicate nerves, and it was found that the bat was thus made aware of the neighbourhood of an obstacle, and enabled to avoid it accordingly.

The fur of the bat is of a very soft and silky nature, and the hair is a most beautiful object under the microscope. It is densely clothed with scales somewhat resembling those of a butterfly's wing, which are arranged in circles round the hair, a short distance from each other. The whole object bears a wonderfully strong resemblance to the well-known mare's-tail plant.

Easy and graceful as are the movements of the bat whilst disporting itself in the air, it is a very different creature when attempting to walk upon a level surface. Its mode of progression can at best only be described as an awkward waddle, the creature hitching itself along by means of the claw at the extremity of one of the wings, giving a kind of tumble forwards, at the same time advancing the corresponding foot; the same process is then repeated with the other wing.

In the illustration representing the bats in a cave, the extraordinary attitude assumed in walking is well shown. The long finger-joints are pressed together, their tips projecting on either side of the back. The weight of the body rests on the wrist, and the creature pulls itself forwards by hitching the claw of the thumb upon any roughness of the surface on which it walks.

Bats are remarkably averse to taking to the wing from a level surface, and always prefer to climb to some little height from which they can throw themselves into the air. This is evidently the reason for the strange and apparently uncomfortable attitude adopted when at rest, the animal being then in the most convenient position for launching itself into the air should there be any signs of danger.

It has been sometimes said that the bat is unable to rise from the ground, but such is not the case; and should the creature be hard pressed, it does not hesitate to do so.

It is able to climb with tolerable facility, and always does so with the tail uppermost, making its way up by the aid of the hind feet, the long claws of which are inserted into any convenient crevice in order to gain a foothold.

The food of all the British bats consists of the various small insects which fly about dusk, and at that time people the air in myriads. The appetite of the animals is almost insatiable, as may be gathered from the fact that a specimen of the short-eared bat, lately kept in captivity by ourselves, consumed daily from forty to fifty blue-bottle flies of the very largest dimensions, rejecting only the wings, and in a few cases the legs. Even upon this allowance, which seldom occupied it for more than twenty minutes, it did not thrive, but gradually wasted away, and finally died.

Bats disturbed in their Cave.

The bat was one which had been found in a hollow tree, and suffering from an injury to one of the wings, which entirely prevented it from flying. It was kept under a glass shade, into which the blue-bottles were introduced. It never took the slightest notice of the insects until nearly dusk, allowing them to crawl over all parts of its body without manifesting the least signs of activity. As soon, however, as the day began to close in, it was on the alert, and immediately set to work devouring the flies which had been procured for it.

This it did in the following manner:—

Resting upon the floor of its cage, it remained motionless until a fly settled within a few inches. It then began, by an almost imperceptible movement, to approach the insect, and when within an inch or so of it, with a sudden spring, clutched the insect between the wings, and holding them tightly together, bent down its head, and swallowed its captive. If a fly happened to take flight before the bat was near enough to make its spring, it merely remained motionless until another presented itself.

It was fiercely voracious when it once began to feed, and scarcely had one fly been swallowed than the bat was eagerly looking out for another. Its attitude when thus engaged strongly reminded us of that of the toad or the green crab when hunting after prey.

Though as a rule a nocturnal creature, owing to the habits of its prey, the bat may occasionally be seen flying in broad daylight, and sometimes, in the early spring, even hawking for the insects which are enjoying the warmth of the sun. In these cases, it is probable that the bat, having for the first time left the retreat where it had passed the winter in a torpid condition, has felt the want of food, and knowing instinctively that no insects would be on the wing at sunset so early in the year, has so far altered its usual habits as to prosecute its search by day instead of by night.

Most bats, however, resort to dark and retired hiding-places during the day, and in some parts of the world there are large caves which are celebrated as haunts of the bats. When travellers visit these caves, the guide will fire a gun into the cave for the purpose of startling the bats, which come rushing out in such numbers that unwary visitors have been fairly knocked down by them.

In Great Britain alone, there are nineteen catalogued species of bats, many of which, however, are rare, and very seldom seen. One of the commonest is the Long-eared Bat (*Plecotus communis*), which abounds throughout the British Islands. It derives its popular title from the great length of its ears, which stand out for some distance from the head, and which are thrown at every moment into a variety of graceful folds. In consequence of its gentle temper, this bat is easily tamed, and is often kept as a pet, coming when called by those with whom it is familiar.

Another of the British bats is the Noctule, or

Great Bat (*Noctulinia altivolans*), which is remarkable for the great height at which it usually flies. The specific name, *altivolans*, refers to this habit. It is the largest but one of the bats found in this country, being almost three inches in length from head to tail, while the spread of the wings is nearly fourteen inches. Its cry is remarkably keen, and, like that of some other species, closely resembles the squeak which can be produced by rubbing two keys sharply together. So shrill is the cry of the bat, that to many, among them even practised musicians, it is perfectly inaudible, the note produced being too attenuated to make any impression upon the ear.

A curious development of the nasal organ is found in the Horse-shoe Bat (*Rhinolophus Ferrum-equinum*), which is also a native of this country. It consists of a membrane, commencing at the lips, surrounding the nose, and projecting upwards for some little distance. Immediately behind it is a second membrane, placed on the forehead, and sharply pointed. It has been thought that the object of the structure is to increase the delicacy of the sense of smell. The same apparatus is found in the Vampire Bat, and is there developed to even a greater extent.

Head of Horse-shoe Bat.

In other parts of the world, and especially in tropical climates, are found many other species of bat, some of them reaching the tremendous dimensions of nearly five feet in stretch of wing. This is the case in the well-known Kalong of Java (*Pteropus rubricollis*), which is often known as the Flying Fox, or Roussette. This, instead of feeding upon animal food, finds its subsistence in fruit, and is often the cause of terrible damage to the agriculturist. In some districts, indeed, where the bat is more than usually abundant, it is even necessary to envelope the whole of the fruit in a bamboo network, in order to secure it for human consumption. By way of a counterbalancing advantage, however, the flesh of the Kalong is eaten in many places, and is even considered a great delicacy.

A curious point about the Kalongs is, that they do not trouble themselves to find a dark and retired spot in which to pass the daytime, but hang in large clusters from the boughs of various trees, especially those of the fig tribe, where they are hardly recognisable as bats, resembling clusters of fruit more than anything else.

Perhaps the most widely known and famous of the bat tribe is the Vampire Bat (*Vampyrus spectrum*) of South America. It is by no means one of the largest of the family, its total length being six or seven inches only, while the spread of wings is not more than a couple of feet.

The blood-sucking propensities of this animal are well known, men and animals alike suffering from its attacks.

Settling upon its victim when plunged in slumber, it perforates with its sharp teeth any exposed portion of the body, generally selecting a toe as the point of operations, when it attacks a human being, and then sucking the blood from the wound until it is thoroughly satiated, a condition which seldom ensues until a considerable quantity of blood has been abstracted. The bite causes no pain at the time, and very little afterwards, the only ill effects arising from the loss of so large a quantity of blood.

The Vampire seems rather capricious in its tastes, for while one person may suffer from its attacks night after night, another individual, reposing perhaps only two or three feet distant, may leave his feet uncovered with perfect impunity, the bats never attempting to interfere with them. The late Mr. Waterton was one of these fortunate individuals. When travelling in British Guiana, with the hope of ascertaining exactly the mode of the vampire's attack, and the effects of the bite, he slept for several months in an open loft, purposely leaving his feet exposed. Yet, though the bats were frequently seen hovering over his hammock, and a young Indian, who also slept there, was repeatedly bitten, he was never attacked.

Cattle are great victims to the ravages of the vampires, which often reduce them to a mere mass of skin and bone by the frequency of their attacks. The wound is usually inflicted upon the flanks of the animal, just where the teeth or feet of the victim cannot reach it; and in cases where there is pressure from harness or other causes, often leads to considerable damage.

None of our British species are capable of harm, the teeth being too small to produce any impression upon the skin. Among the lower classes, nevertheless, bats are held in the greatest dread, and many a countryman would as soon handle an enraged viper as one of these harmless little creatures.

Short Historical Anecdotes.

BY REV. SIR GEORGE W. COX, BART., M.A.

(18) Paulinus and Edwin of Northumbria.

Among the stories related of the conversion of the English after their conquest of Britain, one of the most noteworthy is the legend of Paulinus and Edwin, king of the Northumbrians. In his early years Edwin had gone through much care and anxiety. His predecessor Ethelfrith sought his life, and Edwin found a refuge with Redwald, the East Anglian chief; but Redwald, either through fear of Ethelfrith or seduced by his lavish bribes, wavered in his good faith to the exile, who knew not whither he could now betake himself with any chance of safety. As he sat alone brooding over his troubles, he saw standing near him a stranger, who asked him why he remained there on the cold stones while all others were asleep. With some bluntness, Edwin retorted by asking the stranger what it could matter to him whether he spent the night within doors or abroad. The stranger replied that he knew well what his troubles were, and asked what he would give to one who should bring him the assurance that Redwald would neither do him any harm himself nor suffer others to do so. Edwin's answer was that he would do anything in his power as a requital for such a benefit. 'But,' added the stranger, 'what will you do if I assure you further, that you shall not only live, but be more powerful than any of the kings who have ruled before you over the nations of the Angles?

Still more, if the man who now foretells the good fortune which shall befall you in this life can also give you, for your salvation in the life to come, better counsel than any of which your forefathers ever dreamed, will you submit yourself to his guidance and direct your life by his precepts?' Edwin promised that assuredly he would do so. Having received this pledge, the stranger laid his hand on his head, saying, 'When this sign shall be given you, remember the words which have now passed between us, and keep thy faith;' and having so spoken, he vanished from his sight.

So far as they concerned Redwald, the predictions of the stranger were soon fulfilled. The East Anglian chief steadily refused to betray Edwin, and the exile, on the death of Ethelfrith, whose army he defeated near Retford, became king of the Northumbrians. But Edwin, it seems, had forgotten his conversation with the mysterious stranger, and was in no haste to become a Christian at the bidding of Paulinus, one of the companions of Augustine, whom Gregory the Great had sent from Rome for the conversion of the English. At last, as Edwin was sitting alone, Paulinus came to him, and laying his hand on his head, said simply, 'Do you know this sign?' Edwin at once acknowledged his promise and declared his readiness to abide by it, but added, that he would first take the advice of his council in the hope that all might confess the faith of Christ together.

With his councillors he had little trouble. The arch-priest Coifi boldly argued from the little that he had himself received to the worthlessness of the deities who had been so niggardly to him. 'None of your people has applied himself more diligently to the worship of our gods than I: yet many are preferred to me, and are more prosperous in all that they take in hand. Now if the gods were good for anything, they would rather favour one who has been more careful to serve them. If, then, the doctrines which the strangers preach should on examination be found more useful, my judgment is that we receive them without delay.'

Another of his men, following a train of thought which we find indicated in the book called *The Wisdom of Solomon* (v. 11), compared the life of man to the passage of a bird, which on a stormy winter's night finds its way into a warm and well-lighted room, and having there for a while fluttered about, disappears into the darkness outside. During that short time, the sparrow is safe from the storm; and so seems man to be during his pilgrimage on earth. 'But of what went before and of what is to follow, we know nothing at all. If, therefore, this new teaching brings us more certain tidings, surely we ought to follow it.'

Paulinus then told them what it was that he had come to teach them; and Coifi with the rest acknowledged at once that his words opened to them the way to eternal life. Having confessed the faith of Christ, he was eager to prove his sincerity in renouncing the gods whom he had served. 'Let us abjure them forthwith,' he said, 'and set fire to the temples and altars which we have consecrated without getting any profit from them.' 'But who will dare to set fire to them?' asked Edwin. 'I,' answered the arch-priest, 'for who can show a better example than I by destroying the idols which in my ignorance I worshipped?' So he asked the king to let him have arms and a horse, for the priests could not lawfully carry weapons or ride except on a mare. So mounted with a sword by his side, and a spear in his hand, he hastened to the temple, the people looking on in amazement, and thinking that he was mad. Having reached it, he hurled his spear at the idol, and then hewing it down with his sword, ordered the place to be set on fire. The people seeing the deities thus powerless to avenge themselves, promptly obeyed his command; and so was achieved the conversion of Northumbria by Paulinus, the first archbishop of York.

(19) The Penance of Henry IV. at Canosa.

The power of the Pope was never exercised more daringly than in the humiliation of the Emperor Henry IV. at Canosa (A.D. 1077); but it should not be forgotten that the strength of the pontiff lay in the wickedness and tyranny of the temporal sovereign. Gregory the Seventh, or (to speak of him under his more familiar name) Hildebrand, would never have been able to trample on the German king if the latter had not roused a feeling of deep hatred for himself in the great body of the people. When at last, after a long struggle, the Pope gave sentence that unless within a year the king should come in person to make confession and obtain absolution, his subjects should be absolved from their allegiance, Henry turned instinctively to the Diet or Parliament of his kingdom. He was lavish in his promises; he pledged himself to do all that they could require of him. But the answer was, that his pledges and promises were shown by experience to be spiders' webs. He had made them by hundreds, and they had all been broken. The terms on which they insisted seemed to be harder even than those of the Pope. He was to surrender all his authority, to go and live as a private man at Spires, and he was to obtain absolution from the Pope in person before the expiration of a year from the date of his sentence, under pain of forfeiting his crown altogether if he should fail to do so.

The Pope had said that he was coming to Germany. Henry resolved to be beforehand with him, and to confront him in Italy. But it was now winter, and such a winter as had not been known for years or for generations. For five months the Rhine was so frozen that men could walk over it, although its stream is vastly more rapid than that of the Thames. Henry's journey over the Mont Cenis into Italy was one of terrible suffering. It was hard to reach the summit; it was harder still to descend on the other side. The queen and her infant child were drawn down sledge-wise in the skins of oxen. The horses they lowered as best they could: some with their feet tied were allowed to roll down the ledges, most of them being killed, and few reaching the plain in a state fit for any service.

Meanwhile, some of the most prominent supporters of the king had made their way to the Pope, who had absolved them after comparatively slight penances; and this lenity seemed to justify the hope that the king might receive the same treatment. He was soon undeceived. The Castle of Canosa, in which Hildebrand was now lodged, was surrounded by three lines of wall, one within the other. Clothed only in the thin white penitential dress, the king presented himself at the outermost gate, and was admitted

a number of 20's, and we soon find 60—the *least* common denominator, or least common multiple, generally expressed by L. C. M. Here I would explain to the class that *any* common multiple—120 or 240, etc.—would do, but that the least is the most easily worked. Work a question successively by different common denominators, and they will observe that it is more easily done by the least. As to illustrations by the 'Fractograph,' I find in practice that the best fractograph is the *impromptu* simple representation of dividing lines or circles fractionally when such illustration can be made serviceable, as it very often may, to beginners.

(*b*) Show that *subtraction* of simple fractions requires the same preparation—common denominator—as addition:

$$\tfrac{7}{8} - \tfrac{3}{5}$$
$$= \tfrac{35}{40} - \tfrac{24}{40} = \tfrac{11}{40}. \quad \text{Ans.}$$

Make the above and a few similar exercises the basis of the few explanatory remarks required.

(*c*) Explain the term *mixed number*, and add such numbers together:

$$3\tfrac{5}{6} + 7\tfrac{3}{4} + 8\tfrac{5}{16} + 10\tfrac{3}{8}.$$

Here we simply first add together the fractions, which amount to $\frac{109}{48} = 2\frac{13}{48}$, to which the 28 integers are added, making $30\frac{13}{48}$. Explain also here clearly the principle and mode of bringing a mixed number to an *improper* fraction, and explain also the meaning of this expression—a fraction *equal to* or *greater than* a whole one. Remark also, that in working fractions we have often to convert mixed numbers into improper fractions, and *vice versa.*

(*d*) Simplify *compound* fractions. Explain the meaning of the term—a fraction of a fraction, or a part of a part. Elicit orally that $\frac{1}{2}$ of $\frac{1}{2} = \frac{1}{4}$, $\frac{1}{2}$ of $\frac{1}{2}$ of $\frac{1}{4} = \frac{1}{16}$, $\frac{1}{2}$ of $\frac{1}{6} = \frac{1}{12}$, etc.; and show that these results are obtained by multiplying together all the numerators to produce the numerator of the simple fraction, and all the denominators for its denominator. Here show the necessity of bringing any term which is a mixed number to an improper fraction,—($\frac{2}{3}$ of $2\frac{1}{2}$ of $5\frac{4}{5}$) = ($\frac{2}{3}$ of $\frac{5}{2}$ of $\frac{29}{5}$). Here cancelling the fives and the twos, we have $\left(\frac{\cancel{2}}{3} \text{ of } \frac{\cancel{5}}{\cancel{2}} \text{ of } \frac{29}{\cancel{5}}\right) = \frac{29}{3} = 9\frac{2}{3}$. Here explain the theory of cancelling,—that if the numbers were multiplied fully out we should obtain $\frac{290}{30}$, which is now divisible by 10, equivalent to the product of the two numbers (5 × 2) that we cancelled, giving $\frac{29}{3} = 9\frac{2}{3}$ as before. Here remark also, that if any number will *divide* any two numbers respectively in any numerator and denominator, the two numbers can be cancelled, and their respective quotients put in lieu of them. Caution the scholars to be very careful in cancelling, as the operation is often difficult to retrace in case of error, but must be again put down and done *de novo.*

(*e*) As the process of *multiplying* fractions is precisely the same as bringing a compound fraction to a simple one, it best follows at this stage, needing, however, few additional remarks,—thus $\frac{2}{3} \times \frac{5}{8} \times 4\frac{1}{2} \times 5\frac{1}{5}$ is the same as $\frac{2}{3}$ of $\frac{5}{8}$ of $4\frac{1}{2}$ of $5\frac{1}{5} = \frac{\cancel{2}}{\cancel{3}} \text{ of } \frac{\cancel{5}}{\underset{4}{\cancel{8}}} \text{ of } \frac{\overset{3}{\cancel{9}}}{\cancel{2}} \text{ of } \frac{\overset{13}{\cancel{26}}}{\cancel{5}} = \frac{39}{4} = 9\frac{3}{4}$. Multiply $\frac{2}{3}$ by $\frac{3}{4}$,—here $\frac{2}{3}$ is to be multiplied by the fourth part of 3. Now 3 times $\frac{2}{3} = \frac{6}{3} = 2$, which must now be divided by 4, giving $\frac{1}{2}$ as the result.

We will explain the theory of dividing more in detail, after which the principle of multiplication will be easily comprehended.

Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

Joint-Author of 'The Field Naturalists' Handbook.'

I.—WHAT IS AN INSECT.

AT the commencement of these papers on Insect Life, it will be as well that we should have a settled idea as to what an insect is, and I shall therefore, in this opening article, endeavour to point out the chief characteristics of insects, and show how they may be distinguished from other classes of animals.

In the first place, insects belong to the great group of animals which are known as *Annulata*, or those whose bodies are composed of a number of rings, or 'segments.' In the insects, the number of these segments is invariably thirteen.

Each of these segments is composed of two half-rings, placed one above the other, and connected by an elastic membrane, which is capable of considerable expansion. The reason for this structure we shall presently see.

Besides the division into thirteen segments, the body of an insect is boldly divided into three chief portions, known as the *head*, containing the mouth and organs of sensation; the *thorax*, bearing the organs of locomotion; and the *abdomen*, containing the vital organs. This division into three portions constitutes one of the chief characteristics of the insect, and the word In-sect, *i.e.* cut-into, refers to this division. The Greek word *entomos*, from which is formed the word entomology, has the same signification. All insects, too, after being hatched from the egg, pass through two preliminary stages, viz. the larva, caterpillar, or grub, and the chrysalis or pupa, before attaining their perfect condition. These stages, which are technically termed *metamorphoses*, will be more fully described in the succeeding paper.

Another important distinction is that all insects have six legs, neither more nor less, though in some cases they are not all fully developed. It is thus easy to see why spiders do not rank as insects, in spite of the popular notion to the contrary; for, in the first place, the body is divided into two chief portions only, the head and thorax being fused into one, called the *cephalo-thorax*, or head-thorax, which combines the functions of both parts. Besides this, they have eight legs instead of six, as well as several other minor differences.

Of the thirteen segments which make up the body of an insect, the HEAD is the first, and contains the mouth and the organs of the various senses, which we will examine in turn.

The mouth is found in various forms, each being most suitable to the food which the insect consumes. The beetles and many other insects, for instance, are provided with a pair of powerful horny jaws, often more or less toothed, which invariably work from side to side, instead of up and down, as is the case in the higher animals. Placed beneath these jaws is a pair of lesser size, known as the *maxillæ.*

Some insects, such as the butterflies and moths, are furnished with a flexible tube, which can be inserted

into flowers, and their juices sucked up into the mouth by its means. This organ is usually known as the trunk or *proboscis*, and is not merely a simple tube, as might perhaps be imagined. In reality, it is formed by two separable half-tubes, composed of innumerable joints, and connected to each other by means of a series of small hooks, the two portions thus forming a complete tube, through which liquid nourishment can be imbibed. While not in use, the proboscis is usually coiled away beneath the head. Its structure may be readily examined by procuring a recently-killed moth or butterfly, and drawing the organ out with a pin or other instrument. If care be taken, the two portions may be separated, and their structure investigated by means of a microscope or powerful magnifying-glass.

Many insects, besides being furnished with a proboscis (which, in these cases, is not capable of being coiled up), have a further apparatus, consisting of a series of lancets, for the purpose of piercing the skin before proceeding to imbibe the blood. In the common gnat this structure is strongly exemplified.

Connected with the mouth are two pairs of feelers, varying greatly in size and form, which are termed *palpi;* the first pair, situated upon the maxillæ, or lesser jaws, being termed in consequence the maxillary palpi; and the second pair, placed on the labium, or lip, the labial palpi. Their use is supposed to consist in investigating the substances upon which the insect feeds. In many insects they are very imperfectly developed.

The eyes of insects are of two kinds, simple and compound, both forms being generally found in the same insect. The compound eyes, two in number, are placed one upon each side of the head. They are always more or less convex, and are composed of a considerable number of lenses, varying from twenty-five in each eye in certain species of ants, to about eighteen thousand in some of the butterflies. Each of these eyes is hexagonal in form, and possesses a perfect visual apparatus, so that some insects are furnished with the astonishing number of thirty-six thousand distinct eyes. Of course, it is not to be supposed that each of these eyes produces a separate impression upon the optic nerves; and as the eyes are immoveable, it is probable that one only, or at any rate a very small number of the facets are in focus with any given object at the same time. Hence the want of moveability is compensated for by the number of lenses, each of which points in a different direction, and commands a separate field of vision.

The simple eyes are usually very few in number, and are generally situated upon the upper surface of the head. Though both forms are generally found in the same insect, this is not always the case, sometimes the one and sometimes the other being alone found. Some few insects, indeed, among them several of the beetles and exotic ants, are entirely without eyes of either description.

Though it is undoubtedly the case that many, if not all insects, possess the sense of smell, it is yet unknown where the organs of scent are placed. The various carrion-feeding insects, for example, evidently detect the presence of their food by its odour; moths, and many other insects, which feed upon the sweet juices of flowers, must do the same; yet, although many theories have been advanced upon the subject, we have still to detect the organs devoted to the sense.

Neither have the organs of hearing been satisfactorily identified, unless, perhaps, the antennæ perform those functions. Yet the sense must be there, for many insects—as, for instance, the grasshoppers and crickets—evidently possess the power of appreciating sound and communicating by its means.

We invariably find upon the head of an insect two organs, varying to a great extent in form and size, which are popularly known as 'feelers,' or 'horns,' and scientifically as *antennæ*. They are composed of a number of joints, but are perfectly dissimilar in various insects. In the butterflies, for example, they are slight and thread-like, until within a short distance of the end, where they suddenly enlarge into a knob. Among the moths, they are sometimes entirely thread-like, and sometimes heavily plumed, either for part or the whole of their length. This plumed structure is often found in the male, and the simple in the female of the same insect. In ants, some of the beetles, etc., they are strongly elbowed, and so on.

Their uses have never yet been discovered, some observers considering them to be the organs of the sense of smell; others, of that of touch; while still others suppose them to be the seat of some sense not possessed by and unknown to man. It is certain that they have the power of communicating impressions to the mind of their owner, as no one can for a moment doubt who has seen an ant examining an obstacle carefully with its antennæ before proceeding upon its way.

Passing to the second of the chief divisions of the body, namely the THORAX, bearing the various organs of locomotion, we find that it again is subdivided into three portions. Of these, the first, or *pro-thorax*, bears the first pair of legs; the second, or *meso-thorax*, the second pair of legs, and the upper pair of wings, and the half of the last pair of legs; the last, or *meta-thorax*, bears the lower wings, and the other half of the last pair of legs.

The legs are formed of joints, corresponding somewhat to those of our own limbs, and therefore named in accordance with them, viz., the *femur*, or thigh, next the body; the *tibia*, or leg; and the *tarsus*, or foot. This last usually consists of five joints, terminated by either a single or a double claw. The place of the hip-joint is taken by the *coxa*, which performs much the same functions.

The wings are formed of a transparent membrane, stretched between stout ribs, or *nervures*, of a strong, horny substance, which usually branch off and connect with each other in such a way as to form a perfect network. The whole structure is a wonderful combination of lightness and strength.

In many insects, and more especially the butterflies and moths, the wings are thickly covered with scales, which are most exquisitely sculptured and variegated, although so small that a powerful microscope is necessary to reveal them as anything more than a slight dust upon the wings. They are arranged in rows, one slightly overlapping the other, like slates on the roof of a house, and are but loosely fastened to the wing, a very slight touch being sufficient to detach them from their position.

In the beetles, the upper pair of wings are entirely of a horny consistency, and are not used in flight, being merely employed to protect the under pair which are folded away beneath them while the insect is at rest. In the *diptera*, or two-winged flies, the

upper wings alone are developed, the lower pair being merely represented by a couple of small knobs, termed *halteres*, or balancers, which assist in preserving the equilibrium of the body while the insect is upon the wing. In some cases, all four wings are rudimentary only, and are totally incapable of being used in flight.

The ABDOMEN, consisting of the remaining nine segments, contains the vital organs.

WHEN we come to examine the internal structure of an insect, we find it to be so different to what we might expect from an acquaintance with the higher forms of animal life, that we should hardly recognise the various organs in their simpler and less developed forms.

Insects possess neither skeleton, heart, lungs, nor brain, as we understand the words, the whole structure being essentially unlike that of the vertebrate animals.

The place of the skeleton is taken by the hard shell of the insect, which provides the necessary strength and rigidity, while the elastic membrane by which the segments are connected allows the body to be curved in any required direction, thus performing the office of joints.

The mass of nerves, which answers the purpose of a brain, runs for almost the entire length of the body, and consists of a number of nerve-bunches, or *ganglia*, generally one to each segment, connected with each other by nerve-chains. On account of this structure, an insect can receive with comparative impunity injuries which would be instantaneously fatal to animals of a higher order of being, for almost every separate nerve-centre must be destroyed before life is fairly extinguished.

From each of these ganglia, branches are sent out to the various parts of the body, but the whole nervous system is of a very slight and imperfect character.

In place of the heart and other circulatory apparatus, we find in the insects a single blood-vessel only, which runs along the back for almost the whole length of the body. This is termed the dorsal vessel, and is furnished with valves at intervals, which regulate the passage of the blood. This dorsal vessel pulsates, although slowly; the blood, after leaving it, passes among the various organs of the body, until it re-enters it at the former end.

The dorsal vessel can easily be examined in any of the smooth and thin-skinned caterpillars, in which it will be seen as a pale streak running along the back. By the aid of a magnifying-glass the pulsations may even be noticed.

The breathing apparatus is constructed upon entirely different principles to that of the vertebrate animals. Instead of nostrils, the insect breathes by means of a series of holes, or *spiracles*, placed along the sides of the body, which open into two large tubes, or *tracheæ*, running for the whole length of the body.

Upon examining one of these spiracles under a microscope, it is seen to be fringed with stiff, elastic, bristly hairs, interlacing with each other in every direction, and effectually preventing the ingress of anything except air. They are usually eighteen in number.

From the tracheæ are thrown off innumerable branches, which permeate every part of the body, penetrating even to the tips of the antennæ and claws. Now we see the reason for the structure of the segments above mentioned, the elastic membrane connecting the two half-rings allowing the body to be expanded and compressed, the air being thus drawn into every part of the breathing system, and expelled in turn.

On account of this wonderful labyrinth of tracheæ, an insect is particularly liable to the effects of any poisonous odour, which, at a single inspiration, is inhaled into all parts of the body, and is quickly fatal. From the same cause, an insect which is unfortunate enough to fall into any greasy liquid is instantly killed, the grease clogging the spiracles and preventing the admission of air into the tracheæ.

The structure of these tracheæ is especially worthy of notice.

One would naturally imagine that when the joints of the limbs are bent, the tubes which supply them would be closed, and the passage of air prevented. Not so, however, for all these tubes are double, one being placed within the other, and between them and surrounding the inner one is coiled a long, stiff, bristly wire, just as is the case in our flexible gas tubes. By this arrangement, a joint can be bent double and the tube yet retain its circular form, the coiled bristle keeping it constantly open. The same structure is found in our veins and arteries, through which the blood passes equally well whether the limb be extended or bent.

The digestive organs are, as regards the general principle, much the same in all insects.

From the mouth, of course, runs the gullet, or *œsophagus*, a very slight and narrow tube, which leads to the stomach. In many insects, however, the food, before arriving in the stomach, is passed into a membranous bag, known as the *sucking-stomach*, and sometimes, but erroneously, as the crop, where it is prepared for digestion. In those insects, also, which derive their sustenance from materials of a hard or tough nature, at the entrance of the crop is found an organ especially adapted for the due mastication of the food, and which, from its analogy to the corresponding organ in fowls, etc., is usually termed the *gizzard*. This varies greatly in form in different insects, but usually consists of six or eight large and powerful jaws, armed with a considerable number of small teeth, which in the cockroach average nearly six thousand. By these numerous teeth the food is masticated, until it is in a fit condition to pass into the stomach, which is merely a large membranous bag surrounded with bands of muscular fibre.

At the junction of the stomach with the intestines is found a mass of fine whitish threads, looking, when the insect is under dissection, like a small piece of cotton wool. Upon carefully drawing out and examining these threads, each is found to be a separate tube, closed at one end, the whole apparatus fulfilling the important functions of the liver. This structure is of the greatest importance to physiologists, proving, as it does, that the primary form of a gland is a simple closed tube.

Having now briefly described the general structure and chief characteristics of the insects, I shall, in the next article, treat of their life-history before they arrive at their perfect condition.

'How I teach Elementary Science.'

OBJECT LESSONS.

BY R. BALCHIN,

Head Master of the Gloucester Road Board School, London.

I HAVE been asked to write a series of articles under the above heading. It is thought my experience may be a guide to some, perhaps. For the last twenty-three years has this experience been accumulating. Before I enter upon the subject-matter, however, I should like to make two things clear—first, why I teach Elementary Science at all in public schools; and second, what I mean by 'teaching Elementary Science.'

Strange though it may seem, there are several reasons that may be advanced in favour of such teaching. There is, for instance, reason number one, viz., that a grant of money may be earned by the teacher on every scholar who passes what is called an 'examination.' With many, Science would not be taught at all but for this reason. It is the sole aim and moving force. But considering that I and my enthusiastic assistant, Mr. Ballantyne, now well known to the School Board for London, taught Science for at least twelve years without one penny of payment, and should continue to teach it now, grant or no grant, this reason is certainly not the exclusive one with me. Then there is reason number two—that it is an agreeable change to the teacher from the everlasting drudgery and grinding of mere reading, writing, and arithmetic. But why should the teaching of these subjects be drudgery? Has anybody who has read Fitch's *Science of Arithmetic*, and then taught the subject as there laid out, ever found it to be drudgery? If a man is a mere 'drudge,' then of course whatever he teaches will be mere drudgery. Then there is a third reason,—and this, I take it, should be the one of greatest weight—namely, that we teachers are entrusted with the work of developing and strengthening the mental and moral powers of youths. And in proportion to our success in so doing, will be the ability of the said youths to do battle valiantly in life. For this our work, the most potent means we can possibly employ is the real teaching of Science. To neglect this, then, is to send soldiers to fight without weapons, to clip the wings of birds and expect them to fly. The reason, therefore, I teach Science is this. It is the one great instrument of education, and I profess to be an educator. But what do I understand by 'teaching Elementary Science'? Generally speaking, this — that the teaching shall be first and mainly educative, and second instructive; in other words, that the mental powers may be developed, rather than the memory stored. Hence it will be seen that to buy a stock of twopenny books, give them to the boys, and set them to learn so much, is in no sense what I mean by 'teaching' Elementary Science. By this means the memory may indeed be stocked, ay, crammed with facts, and the boys may be skilfully trained to disgorge all this undigested food on the particular occasion of an examination. The great evil of a written examination being that it can gauge the extent to which the memory only has been packed, but can take no note of the real educative work that has been done, though this latter is incomparably the more important. In the ordinary run of school life, there are two opportunities presented for science teaching — object lessons, and the preparation of the scholars for the special subjects of the 'Fourth Schedule.' I have always arranged my time-table so that there should be at least two object lessons per week in each division of the school, including even the First Standard. The direct and indirect results have been so valuable, that I shall continue this system so long as I am a teacher. But two things are necessary — a school museum of objects, and teachers in the school who can teach. As to the museum, this consists in my school of well-filled cases fastened against the walls of the rooms, but not reaching to the floor. The cases are about six feet long, four feet high, and four inches deep. The School Board would not furnish me with these, so, being a carpenter, I made them myself. Case No. 1 is filled with chemical apparatus, and models of crystal forms; No. 2, entomological specimens; No. 3, a fairly complete mineral collection of about 300 specimens, arranged according to Dana's classification; No. 4, odds and ends for object lessons in Standards I. and II.; No. 5 (a cupboard), electrical apparatus, made mostly by the boys themselves; No. 6, a collection of botanical specimens, dried and mounted on card-board, illustrating most of the natural orders of plants.

These cases fill so rapidly with specimens brought by the boys, that I have now in one of the school cellars large boxes full of objects waiting space to be exhibited. Thus much for the museum. Now for the teachers. This is, I fear, a more serious difficulty than the museum. The so-called 'training colleges' turn out students rather than educators. I have met with very few assistants who could give a really good object lesson. Their usual manner is dry and mechanical. A few years ago, an assistant newly engaged in my school had to give an object lesson. He chose as his subject 'Coal.' After the lesson, I went into his classroom and asked him if he had given the lesson. 'Yes,' said he, 'there it is,' pointing to the black-board, where there certainly was a remarkably neat arrangement of 'notes.' 'But,' said I, 'I wanted it *there*,' pointing to the boys. I then took a piece of coal in one hand, and a piece of granite in the other; holding them up before the boys, I asked in what respect the coal differed from the granite. The answer sure enough was the first of the 'notes,' namely, 'Coal is an opaque, black substance.' I almost laughed outright. Calling the teacher on one side, I told him that I was, that same evening, to give a geological lesson on the 'Post-tertiary' formation, and should have occasion to describe that huge fossil elephant the 'mammoth.' 'But,' said I, 'what would you think if I began thus: "Ladies and gentlemen, the mammoth, we have every reason for believing, was an enormous pachydermatous creature, that you couldn't see through, it was opaque"?'

However, if the school has the museum, and the good fortune to secure such capital assistants as I have at present, there is no reason why there should not be a good system of object lessons, which will not only earn the extra grant of £5 per annum that the Board has recently decided to give, but also the future gratitude of boys who, in their life-work, will find that the common sense, thoughtfulness, and

powers of observation that have been developed by such teaching, are the most powerful means in their possession for raising them above their fellows. It is my usual plan to arrange a 'scheme' or 'table' for object-lesson subjects for each Standard of the school, including even the First Standard. In my next article, I will lay before my readers the plan now in use.

(*To be continued.*)

Science and Art Department.

SOLUTIONS TO SCIENCE PAPERS IN MATHEMATICS.

BY W. T. KNIGHT, F.S.SC., LONDON,

Science Teacher, formerly Mathematical Master at New College, Southsea; Author of 'Algebraic Factors, how to find them and how to use them;' 'Solutions to Science Papers in Mathematics,' etc.

Stages I. and II., 1880.

AT the examination in Mathematics, Stages I. and II., held in connection with the Science and Art Department, South Kensington, April 26, 1880, 9333 candidates presented themselves in the First Stage, and 1433 in the Second Stage. The results were as follows:—

	1st Class.	2d Class.	Failed.
First Stage,	1945	3880	3508
Second Stage,	150	714	569

Three hours were allowed for each paper, and the number of marks assigned to each question was given in brackets. In each stage the paper was divided into three sections, and in order to pass, it was necessary to obtain marks in every section. Candidates were not allowed to answer more than three questions in any one section, and not more than eight questions altogether.

STAGE I.

Section I.—Arithmetic.

1. Divide 285651 by 77, using only short division. Obtain the remainder correctly, and explain briefly how you obtain it. (6)

$$\begin{array}{r} 11\,)\,285651 \\ 7\,)\,\underline{25968}+3 \\ 3709+5 \end{array}\Big\}\ 58 \text{ remainder.}$$

Multiply the last remainder by the first divisor, and add in the first remainder. The first remainder 3 is really $\frac{3}{11}$, and when we obtain the second remainder 5, we have to divide $5\frac{3}{11}$ by 7. Now $5\frac{3}{11}=\frac{58}{11}$ (the numerator being obtained by multiplying 5 by 11 and adding 3), and $\frac{58}{11}\div 7=\frac{58}{77}$, as above.

2. What interest per cent. does a man get for his money by investing in the three per cents at 90? How much must he invest to give him an income of £1153 a year? (6)

(*a*) Interest on $90=3$;

$\therefore$ „ „ $100=\frac{3}{90}\times 100=3\frac{1}{3}$. Ans. (*a*).

(*b*) Sum invested to produce $3=90$;

$\therefore$ „ „ „ „ $1153=30\times 1153$
$=$ £34590. Ans. (*b*).

3. Add together $\frac{5}{9}$ of a guinea, $\frac{17}{20}$ of a half-crown, $1\frac{7}{36}$ shillings, and $\frac{1}{6}$ of a penny, and reduce the whole to a decimal fraction of a pound. (8)

Items:—11s. 8d., 2s. $1\frac{1}{2}$d., 1s. $2\frac{1}{3}$d., $\frac{1}{6}$d. Total, 15s. = £·75.

4. A man owes three bills, of which one could be paid by a certain number of florins, another by twice that number of half-crowns, and the third by six times that number of shillings. The bills amount in all to £7, 3s. What are the several amounts? (12)

1 florin + 2 half-crowns + 6 shillings = 13s,
and £7, 3s. ÷ 13s. = 11.

		£	s.	d.
Hence 1st bill = 11 florins	=	1	2	0
2d bill = 22 half-crowns	=	2	15	0
3d bill = 66 shillings	=	3	6	0

5. Copper weighs 550 lbs., and tin 462 lbs. to the cubic foot. What will be the weight of a cubic foot of a mixture of 6 parts copper to 5 parts tin? (12)

There are 11 parts in all;

$$\begin{aligned} \therefore\ \text{weight of copper} &= \tfrac{6}{11}\times 550 = 300 \text{ lbs.} \\ \text{„ \quad „ \quad tin} &= \tfrac{5}{11}\times 462 = 210 \end{aligned}$$

Hence weight of mixture $=\underline{510}$. Ans.

6. A plate of metal is 106·58 in. long, 14·6 in. wide, and 2 in. thick. Supposing it to be melted, and cast into an exact cube, what would be the edge of the cube? (12)

Volume of metal $=106{\cdot}58\times 14{\cdot}6\times 2=3112{\cdot}136$ c. inches;

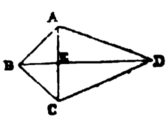
$\therefore$ edge of cube $=\sqrt[3]{3112{\cdot}136}=14{\cdot}6$ inches.

Section II.—Geometry.

7. If two triangles have two sides of the one equal to two sides of the other, each to each, and have likewise their bases equal, show that the angle contained by the two sides of the one triangle is equal to that contained by the two sides of the other. (6)

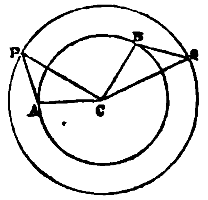
Euclid I. 8.

8. If a quadrilateral figure is divided into two isosceles triangles by one diagonal, show that the diagonals are at right angles to each other. (8)



Let the quadrilateral figure ABCD be divided into two isosceles triangles ABC, ADC by the diagonal AC. Join BD, cutting AC in E. Then in the triangles ABD, CBD we have AB, BD equal to CB, BD each to each, and the base AD equal to the base CD; therefore the angle ABD is equal to the angle CBD (I. 8). Again, in the triangles ABE, CBE, the sides AB, BE are equal to CB, BE each to each, and the included angles ABE, CBE have been proved equal; therefore (I. 4) the angles BEA and BEC are equal, consequently they are right angles.

9. Two circles have the same centre C. Two points A, B are taken on one circle, and two points P, Q on the other, so that the angles ACP and BCQ are equal. Show that the triangles ACP, BCQ are equal in all respects. (10)



Since C is the centre of each

circle, we have AC, CP equal to BC, CQ each to each, also the angle ACP is equal to BCQ, hence (I. 4) the triangles are equal in all respects.

10. Prove that triangles on equal bases and between the same parallels are equal.

ABCD is a parallelogram, of which AB and AD are adjacent sides. On AB, AP is cut off equal to one-third of AB, and on AD, AQ is cut off equal to one-third of AD; show that the straight lines joining CP and CQ divide the parallelogram into three equal parts. (12)

(1) Euclid I. 38.

(2) Draw PM parallel to AD. Now the triangle PBC is half the parallelogram PMCB, which is two-thirds of ABCD. Hence PBC is one-third of ABCD. Similarly QDC is one-third of ABCD. Consequently the remainder QAPC is also one-third of ABCD.

11. Show how to construct a rectangle equal to a given rectilineal figure having five sides. (13)

Let ABCDE be the given figure; join AC, CE. Make a parallelogram FGHK equal to ABC, and having FGH a right angle; to KH apply a parallelogram KHML equal to ACE, and having KHM a right angle; to LM apply a parallelogram LMPN equal to ECD, and having LMP a right angle. FGPN is the rectangle required. Prove as in Euclid I. 45.

12. ABC is an isosceles triangle whose equal sides are AB and AC; produce AB to D, so that BD may equal BC, and join DC. Show that the angle ACD is three times the angle ADC. (13)

ACD is made up of ACB and BCD; but ACB or ABC is equal to BDC and BCD (I. 32), and BCD is equal to BDC (I. 5). Hence ACD is equal to three times ADC.

Section III.—Algebra.

13. Find the value, when $x=5$, and $y=3$ of

$$\frac{x^4-4x^3y+6x^2y^2-5xy^3+2y^4}{2x^4-5x^3y+6x^2y^2-4xy^3+y^4}. \qquad (6)$$

The expression

$$=\frac{(x-y)^4-xy^3+y^4}{(x-y)^4+x^4-x^3y}=\frac{(x-y)^4-(x-y)y^3}{(x-y)^4+(x-y)x^3}$$

$$=\frac{(x-y)^3-y^3}{(x-y)^3+x^3}=\frac{8-27}{8+125}=-\frac{1}{7}.$$

The same result is obtainable by merely substituting the given values and reducing.

14. Multiply a^3-x^3 by a^2-x^2, and divide the product by $(a-x)^2$. (8)

Answers:—$a^5-a^3x^2-a^2x^3+x^5$,
$a^3+2a^2x+2ax^2+x^3$.

15. Simplify $(a-b)(b+c)(c+a)+(b-c)(c+a)(a+b)+(c-a)(a+b)(b+c)$, and find its value when $a=1$, $b=3$, and $c=-2$. (10)

Removing the various brackets by multiplication, and collecting terms, the expression becomes

$$a^2b-ab^2-a^2c+ac^2+b^2c-bc^2=(a-b)(ab-ac+bc+c^2)$$
$$=(a-b)(a-c)(b-c)=-2\times3\times5=-30.$$

16. Solve the equations:— (12)

(*a*) $$7\left(x+\frac{1}{3}\right)-5x\left(\frac{1}{3x}+\frac{1}{2\frac{1}{2}}\right)=4. \qquad (6)$$

(*b*) $$\left.\begin{array}{l}0{\cdot}5x+0{\cdot}07y=0{\cdot}93\\0{\cdot}03x-0{\cdot}4y=0{\cdot}46\end{array}\right\} \qquad (6)$$

(*a*) Removing brackets,

$$7x+\frac{7}{3}-\frac{5}{3}-2x=4,$$

i.e. $$5x+\frac{2}{3}=4,$$

$$5x=3\frac{1}{3};\ x=\frac{2}{3}.$$

(*b*) Moving the decimal points two places to the right throughout,

$$50x+7y=93, \quad . \quad . \quad (1)$$
$$3x-40y=46; \quad . \quad . \quad (2)$$

whence in the usual way, $x=2$, $y=-1$.

17. The rent of a shop is two-sevenths of the rent of the whole house of which it is a part. Being separately rated, its occupier pays £10, 15s. 0d. a year less in rates than the occupier of the rest of the house. The rates are 3s. 7d. in the pound. What is the rent of the whole house? (14)

Let $x=$ rent of the whole house in pounds.

Now difference between the rates of the two occupiers $=\frac{5}{7}-\frac{2}{7}$, or $\frac{3}{7}$ of the whole rates.

Thus, by question,

$$\frac{3}{7}\times\frac{3s.\ 7d.}{20s.\ 0d.}\times x=10\tfrac{3}{4};\ \text{whence } x=£140.$$

18. Find, as a fraction in its lowest terms, the value of $\dfrac{1}{x^3-3x^2-15x+25}-\dfrac{1}{x^3+7x^2+5x-25}$. (12)

$$x^3-3x^2-15x+25=(x^2+2x-5)(x-5);$$
$$x^3+7x^2+5x-25=(x^2+2x-5)(x+5).$$

Hence the fraction required is

$$\frac{(x+5)-(x-5)}{(x^2+2x-5)(x-5)(x+5)}=\frac{10}{(x^2+2x-5)(x^2-25)}.$$

STAGE II.

A table of logarithms must *not* be used in working this paper. All the logarithms needed will be found in the accompanying table:—

log	2	3010300
	3	4771213
	4	6020600
	7	8450980
	9	9542425
	11	0413927
	34608	5391765
	34609	891
	38712	5878456
	47162	6735922
	47163	6014
	62219	7939230
L sin	9° 36′	9·2221147
	35° 15′	9·7612851
	51° 27′	9·8932426
L tan	29° 44′	9·7567587
	29° 45′	70520
	52° 7′	0·1090139
	52° 8′	2746

Section A.—Arithmetic and Algebra.

21. Assuming that a franc is worth 9·504 pence, and a hard dollar 50·49 pence; what is the smallest sum in francs that can be exactly paid in hard dollars? (16)

$$9\cdot504=\frac{9504}{1000}=\frac{1188}{125}, \text{ and } 50\cdot49=\frac{5049}{100}.$$

Now to find the L. C. M. of two fractions we must take the L. C. M. of their numerators, and the G. C. M. of their denominators; thus the L. C. M. of $\frac{1188}{125}$ and $\frac{5049}{100}=\frac{20196}{25}=807\cdot84$, which is consequently the required sum in pence. Thus the number of francs $=807\cdot84\div9\cdot504=85$. Ans. (This is also equivalent to 16 hard dollars.)

22. Show how to find the square root of a vulgar fraction, so as to make sure of obtaining it in a finite form, if it has one. Ascertain whether the square roots of the following fractions are finite or not: $\frac{343}{1183}, \frac{14641}{243}, \frac{329}{81}, \frac{99}{1331}$. (18)

Multiply or divide both numerator and denominator by some number which will render one of them a complete square; then, if the other be also a complete square, the root has a finite form, and not otherwise. Thus, if $\frac{a}{b}$ be the fraction, and am be a complete square, say s^2, multiply numerator and denominator by m; then $\frac{a}{b}=\frac{am}{bm}=\frac{s^2}{bm}$. Now plainly if bm be a complete square, the root is finite; but if not, it cannot be expressed in a finite form.

Examples: $\frac{343}{1183}=\frac{49}{169}=\frac{7^2}{13^2}$;

$$\frac{14641}{243}=\frac{43923}{729}=\frac{43923}{27^2};\ \frac{329}{81}=\frac{329}{9^2};$$

$$\frac{99}{1331}=\frac{9}{121}=\frac{3^2}{11^2}.$$

Thus $\frac{343}{1183}$ and $\frac{99}{1331}$ have finite square roots; the others have not.

23. Solve two of the following sets of equations:—

(a) $\sqrt{(x^2+a^2)}-\frac{b^2}{\sqrt{(x^2+a^2)}}=\frac{b^2-a^2}{a}$. (10)

(b) $x+y=7,\ x^3+y^3=133.$ (10)

(c) $xy+\sqrt{(x+y)}=11,\ 2xy-\sqrt{(x+y)}=13.$ (10)

(a) Multiplying by $\sqrt{x^2+a^2}$:

$$(x^2+a^2)-b^2=\frac{b^2-a^2}{a}\sqrt{x^2+a^2}.$$

For $\sqrt{x^2+a^2}$ write y; then $y^2-\frac{b^2-a^2}{a}y-b^2=0$,

i.e. $ay^2-(b^2-a^2)y-ab^2=0.$

Factorizing, $(ay-b^2)(y+a)=0$,

whence $\sqrt{x^2+a^2}=\frac{b^2}{a}$ or $-a$.

Thus $x^2+a^2=\frac{b^4}{a^2}$ or a^2.

$$x^2=\frac{b^4-a^4}{a^2} \text{ or } 0;$$

$$\therefore x=\pm\frac{\sqrt{b^4-a^4}}{a} \text{ or } 0.$$

(b) Since $x+y=7$, $x^3+y^3+3xy(x+y)=343$,

i.e. $x^3+y^3+21xy=343$

but $x^3+y^3 \qquad =133$

$$\therefore 21xy=210,\ xy=10,\ y=\frac{10}{x}.$$

Hence $x+\frac{10}{x}=7$, *i.e.* $x^2-7x+10=0$.

Factorizing, $(x-5)(x-2)=0$; $\therefore x=5$ or 2, $y=2$ or 5.

(c) Adding the equations, $3xy=24$, $xy=8$, $y=\frac{8}{x}$.

Multiplying the first equation by 2, and subtracting:—

$$3\sqrt{x+y}=9,\ \sqrt{x+y}=3,\ x+y=9,$$

i.e. $x+\frac{8}{x}=9$, or $x^2-9x+8=0$.

Factorizing, $(x-8)(x-1)=0$, $x=8$ or 1, $y=1$ or 8.

24. What is the least integral multiplier which will make $17x^5-68x^4y+102x^3y^2-68x^2y^3+17xy^4$ a complete cube? (20)

The expression $=17x(x^4-4x^3y+6x^2y^2-4xy^3+y^4)$
$=17x(x-y)^4$.

Hence the multiplier $=\overline{17x}|^2\overline{x-y}|^2=289x^2(x-y)^2$.

25. A rectangular plot of ground measures 42 acres, and its diagonal is 1243 yards long. What are its sides? (22)

Let x, y be the sides; then $xy=42\times4840$ $=203280$ sq. yds. and $\sqrt{x^2+y^2}=1243$.

Hence $x^2+y^2=1545049$

$2xy=\ \ 406560$

Adding, $x^2+2xy+y^2=1951609$, $x+y=1397$.

Subtracting, $x^2-2xy+y^2=1138489$, $x-y=1067$.

Hence $x=1232$ yards, $y=165$ yards.

26. Two boys start at the same instant from the same corner of a square, the length of one of whose sides is 200 yards, and they run round it in opposite directions: one (A) runs at the rate of 100 yards in 15 seconds, and loses two seconds in turning a corner; the other (B) runs at the rate of 100 yards in 16 seconds, and loses one second in turning a corner. Where do they meet? (26)

Let x = number of seconds before they meet.

Now A, who runs faster than B, turns two corners, and loses 4 seconds, $\therefore$ he actually runs for $(x-4)$ seconds; while B, who turns one corner and loses 1 second, runs for $(x-1)$ seconds. Also they together accomplish 800 yards.

$$\text{Hence } (x-4)\frac{100}{15}+(x-1)\frac{100}{16}=800,$$

$$\text{whence } x=\frac{1999}{31}.$$

Hence distance travelled by A

$$=\left(\frac{1999}{31}-4\right)\frac{100}{15}=403\frac{7}{31},$$

from which it appears that they meet $3\frac{7}{31}$ yards past A's second corner.

Section B.—Geometry.

27. Through the corners of a quadrilateral figure straight lines are drawn parallel to its diagonals. Show that the quadrilateral they form is double of the original quadrilateral. (16)

Let ABCD be a quadrilateral, and AC, BD its diagonals. Through A, C draw EH, FG respectively parallel to BD, and through B, D draw EF, HG respectively parallel to AC. Then the resulting quadrilateral EFGH is made up of two parallelograms ED, DF, which are respectively double of the triangles ABD, BCD. (I. 41)

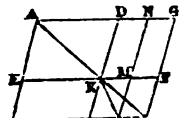
28. Find that point in the circumference of a circle which is nearest to a given point within the circle. What is the locus of a point whose least distance from the circumference of a given circle is constant? (16)

Let O be the centre of the given circle, and P the given point within it. Draw through P the diameter BPOC; then, by Euc. III. 7, PC is the greatest and PB the least of all straight lines from P to the circumference. From this it is manifest that the required locus is a circle whose centre is O.

29. On the same straight line, and on the same side of it, there cannot be two similar segments of circles not coinciding with each other. (18)

Euclid III. 23.

30. Let two equal parallelograms ABCD and AEFG, with their angles at A equal, be superposed so that the sides about A shall be upon one another; then the points of meeting of the sides BC, FG, and of CD, EF (produced if necessary), shall be in one right line with A. (26)



Place the parallelograms as directed, and let BC, GF (produced) meet in H, and CD, EF in K. Join AK, KH; they shall be in one straight line. For if not, produce AK to meet CH, or CH produced in L, and through L draw LMN parallel to AB. Now ABLN is a parallelogram of which the diagonal is AL, ∴ the complements BK, KN are equal. But since ABCD is equal to AEFG and ED is common, the remainders BK, KG are equal. Thus KN is equal to KG, which is impossible. Hence KH must be in a straight line with AK.

31. If two circles intersect, prove that the line joining the points of intersection is perpendicular to the line joining the centres. From any point of the line joining the points of intersection produced, four equal tangents can be drawn to the two circles. (24)

(1) Let the circles ABC, ABD cut each other in A, B. Let E be the centre of ABC and F the centre of ABD, and let the straight lines AB, EF, cut each other in G. Join EA, EB, FA, FB. Then, by Question 8, Stage I., AB is perpendicular to EF.

(2) Produce BA to any point H, on EH as diameter construct a circle, cutting ABC in K, L, and join HK, HL. Then HK, HL are tangents to ABC. In the same way two tangents may be drawn from H to ABD, and, since the square on each of them is equal to the rectangle BH, HA, they are all four equal.

32. If two straight lines fixed relatively to each other intersect in the point P, and if they move in such a manner that each always passes through a fixed point, show that the locus of P is a circle. Explain how the motion must take place, if P is to describe the whole circumference. (26)

Draw any two straight lines cutting in P, and take fixed points Q in one line and R in the other. Join QR, and describe a circle passing through P, Q, R. Now, since the angle QPR is constant, it is obvious that the locus of P is the arc of a segment whose chord is QR. Also, in order that P may describe the whole circumference of the circle, it is necessary that if one line slide along the point R in one direction, the other must slide along Q in the opposite direction. If this be the case, PQ will increase, and PR decrease, till P coincides with R, after which P will traverse the other arc of the circle, and PR will increase while PQ decreases until P coincides with Q.

Section C.—Trigonometry.

33. Why is the logarithm of the product of two numbers equal to the sum of the logarithms of the numbers? What is the logarithm of the fifth root of $\frac{7}{300}$? What is the fifth root itself? (20)

(1) Because the product of two powers of a quantity is found by adding the indices of the powers. Thus, if $m = a^x$ and $n = a^y$, then $mn = a^{x+y}$; ∴ $\log_a mn = x + y = \log_a m + \log_a n$.

$$(2)\ \log x = \log\left(\tfrac{7}{300}\right)^{\frac{1}{5}} = \tfrac{1}{5}(\log 7 - \log 300)$$
$$= \tfrac{1}{5}(\log 7 - \log 3 - 2)$$
$$= \frac{\bar{2}\cdot3679767}{5} = \bar{1}\cdot6735953. \text{ Ans. (2).}$$

$$\text{But } \log \cdot47162 = \bar{1}\cdot6735922.$$
$$\text{Difference} = 31.$$

But difference for 1 = 92, and $\frac{31}{92} = \cdot337$ nearly.

Thus $x = \cdot47162337$. Ans. (3).

34. Find in degrees and decimals, an arc equal in length to the radius, assuming that the ratio of the circumference of a circle to its diameter is 355 : 113. By how much does the length of arc, thus found, differ from that given by assuming the ratio to be 22 : 7, and in which direction? (20)

First: $\text{arc} = \frac{1}{2} \times \frac{113}{355} \times 360° = 57\cdot29577.$

Second: $\text{arc} = \frac{1}{2} \times \frac{7}{22} \times 360° = 57\cdot27272.$

Thus the first result is ·02305 degrees greater than the second, and it is nearer to the true result than the second.

35. On an open plain there is a distant tower (P) in the prolongation of a straight piece of road, and another distant point (Q) to the left of an observer looking towards P. He finds that PQ subtends an angle of 35° 15′; but when he has gone a mile along the road towards P, the angle is 44° 51′. Calculate the distance of Q from the point at which the second angle was observed. (24)

To draw the necessary figure take an acute-angled triangle APQ, in AP take a point B and join BQ. Then AB = 1 mile; QAP = 35° 15′, QBP = 44° 51′.

$$\text{Now } \frac{QB}{AB} = \frac{\sin QAB}{\sin AQB} = \frac{\sin 35°\ 15'}{\sin\ \ 9°\ 36'};$$

$$\therefore \log QB = L \sin 35°\ 15' - L \sin 9°\ 36' + \log 1$$
$$= \cdot5391704$$
$$\text{Now } \log 3\cdot4608 = \cdot5391765$$

$$\text{Difference} = 61$$

$$\text{But difference for } 1 = 126, \text{ and } \frac{61}{126} = \cdot5 \text{ nearly;}$$

$$\therefore QB = 3\cdot46075 \text{ miles.}$$

36. The sides of a rectangle are 4 and 7. What is the angle between the diagonals, to the nearest second? (24)

Let ABCD be the rectangle, and let its diagonals intersect in E. Then the angle DEC is double of EAD. But tan EAD $= \frac{4}{7}$.

Hence L tan EAD $= 10 + \log 4 - \log 7 = 9{\cdot}7569620$

Now L tan $29^\circ\ 44' = 9{\cdot}7567587$

Difference $= \quad 2033$

But difference for $1' = 2933$, and $\frac{2033}{2933}$ of 60 $= 41{\cdot}58\ldots$

Hence EAD $= 29^\circ\ 44'\ 41''{\cdot}58\ldots$ and DEC $= 59^\circ\ 29'\ 23''$ about.

37. Define the tangent of an angle less than 90°; extend the definition when the angle has any magnitude less than four right angles; trace the variations in magnitude and sign when the angle increases from zero to four right angles. If tan $\theta = \frac{9}{7}$, find (1) log tan θ; (2) θ in degrees, minutes, and seconds, the angle being supposed less than a right angle; (3) log cotan θ. (26)

(*a*) Let POM be a right-angled triangle, having the right angle PMO. Then the ratio $\frac{PM}{OM}$ is called the tangent of the angle POM.

(*b*) Let a straight line starting from the initial position OA revolve round the point O, stopping in any position OP. In OP take a point P, and drop PM perpendicular to OA, or OA produced, thus forming a right-angled triangle POM. Then, as before, the ratio $\frac{PM}{OM}$ is called the tangent of the angle POM.

(*c*) With any straight line AA′ as diameter, and O as centre, describe a circle. In the circumference take any point P, join OP, and draw PM perpendicular to AA′; then tan POM $= \frac{PM}{OM}$. Let r be the radius of the circle. Then :—

As the angle increases from 0° to 90°,
PM increases from 0 to r and is positive,
OM decreases „ r „ 0 „ „
∴ tan POM increases „ 0 „ ∞ „ „

As the angle increases from 90° to 180°,
PM decreases from r to 0 and is positive,
OM increases „ 0 „ r „ negative;
∴ tan POM decreases „ ∞ „ 0 „ „

As the angle increases from 180° to 270°,
PM increases from 0 to r and is negative,
OM decreases „ r „ 0 „ „
∴ tan POM increases „ 0 „ ∞ „ positive.

As the angle increases from 270° to 360°,
PM decreases from r to 0 and is negative,
OM increases „ 0 „ r „ positive;
∴ tan POM decreases „ ∞ „ 0 „ negative.

(*d*) tan $\theta = \frac{9}{7}$; ∴ log tan $\theta = \log 9 - \log 7 = {\cdot}1091445$,
and L tan $\theta = 10{\cdot}1091445$

(*e*) But L tan $52^\circ\ 7' = 10{\cdot}1090139$

Difference $= \quad 1306$

But difference for $1' = 2607$, and $\frac{1306}{2607} = \frac{1}{2}$ nearly.

Thus $\theta = 52^\circ\ 7'\ 30''$.

(*f*) log cot $\theta = \log \frac{1}{\tan\theta} = -\log\tan\ $;

∴ L cot $\theta = 10 - {\cdot}1091445 = 9{\cdot}8908555$.

38. Calculate the number of square miles in a triangle whose sides are 11 and 9 miles long respectively, and contain an angle of $51^\circ\ 27'$. What is the length of a side of the square whose area equals that of the triangle? (26)

(1) Area $= \frac{1}{2}ab \sin C$, where $a = 11$, $b = 9$, $C = 51^\circ\ 27'$;
∴ log area $= \log 11 + \log 9 + \text{L}\sin 51^\circ 27' - 10 - \log 2$
$= 1{\cdot}5878478$.

Now log $38{\cdot}712 = 1{\cdot}5878456$, and, as the tabular difference is not given, the nearest approximation to the area which we can obtain is $38{\cdot}712$ square miles.

(2) Let s = side of square, then $s^2 = 38{\cdot}712$.

∴ log $s = \frac{1}{2}\log 38{\cdot}712 = {\cdot}7939228$, and the nearest log we have is log $6{\cdot}2219 = {\cdot}7939230$; hence $s = 6{\cdot}2219$ miles nearly.

Or by actual calculation $\sqrt{38{\cdot}712} = 6{\cdot}2219$ nearly.

—o—

'A Talk about Language and Grammar.'

BY MARTIN F. TUPPER, D.C.L., F.R.S.,

Author of 'Proverbial Philosophy,' etc.

WE learn by teaching. Take a clever boy, and try to explain anything to him: answer his questions as well as you can (albeit to ask a question is far other and more easy than to answer it), solve his doubts where possible, show him the origin of words and the meaning of things, investigate reasons and causes, and you will be surprised how, by such a process, you have cleared your own conceptions in the matter. A man will never rightly understand Grammar, for instance, till he has talked about it, and sifted its phrases and their intention with eager young scholars; and as there would seem to exist very few treatises on this elementary subject (if indeed there are any) which have not been made more difficult from obscurity instead of being easier from clearness, it has occurred to the present writer to set down a few plain explanations of common grammatical terms far too seldom comprehended, which in old days proved of interest and value to his own young circle, with the hope that they may help other teachers and please other scholars.

At all events, and with whatever faults of omission or commission, an important preliminary lesson in education may haply thus be set in a new light; and so far, it is possible that our younger friends at all events may be the gainers. Each and all of us are bound to do what we can at our best for the common good, and should not be deterred from any kind effort to help others up the hill of knowledge, either from fear of a very possible stumble ourselves (for all elementary teaching should be at once deep and clear, simple as truth always is, and therefore not a little difficult), or from the still more unworthy apprehension that we may be lifting our young flocks all too easily to fair standing-places on the mountain which we ourselves have hardly won heretofore by hard scrambling over the rocks.

For, to say truth, the roads to every kind of learning are now much easier and more levelled to all capacities than they were in the old rough ways of our youth. Science, art, and literature are all made more attractive now-a-days than of yore. Where the fierce old pedagogue used to wield his cruel cane over trembling children, who could no more answer his hard questions than, for very ignorance, he could him-

self but for the open book before him, we have the conscientious—not to say courteous—explainer of any difficulty, full of patience for every shortcoming. Where, as in our harsh public school-days, parsons (who had missed or failed in their own vocation, and, fortunately for congregations, had no cure of souls) were the self-interested and self-appointed masters and ushers, reverend without reverence, and too often justly hated or despised, we have now properly trained and certificated teachers, carefully selected for their important functions, and surrounded by pupils who can respect them for their knowledge and appreciate their kindness. Let any old Carthusian—such as is the present writer—remember his juvenile experiences of learning made difficult through bad teaching, and let him join the sarcastic Thackeray in denouncing Dr. Birch. Let the rising generation listen to the hardships endured by their fathers and grandfathers at Winchester, Westminster, and Eton, and rejoice thankfully that those noble institutions have survived to repudiate their ancient sins against the young once committed to their past novercal cruelties, and to compensate them by the wisdoms and amenities of a modern better age.

This discursive Talk about Grammar (not yet begun, by the bye) is perhaps preliminary to other talks about other things which may succeed it, and has no higher ambition than to explain some of the technical difficulties which, utterly confusing the schoolboy on the threshold of learning, somehow never come to be cleared up afterwards. Now, however, in the interest of such explanations, let us at once advance from skirmishing to something nearer allied to systematic drill.

'Talk' is an old word meaning anything told, 'tale-like.' To know the origin of a word is, in most cases, the best way to understand it. 'Language' is derived from *lingua*, the Latin noun or name for a tongue. Sailors still call talking 'lingo,' from a Portuguese word some of them picked up at Lisbon. What the mind thinks, the tongue expresses. Even the lower animals have, each in its class and measure, their languages well comprehensible to themselves and their masters after a fashion: parrots, dogs, horses,—and endless anecdotes about our so-called dumb friends illustrate what we mean. But man, and man only, has the privilege of clearly speaking out what he thinks, and of thinking about what he has to say. It has pleased Providence, for many social and moral reasons, that the language of the human race, originally one, should become multitudinously diversified: one obvious reason being that, in order to people the globe with many separate societies, those who spoke certain variations from the original tongue should segregate and crystallize into separate nationalities, and not all be concentrated to the same dull level of a universal centralization. The various languages of the world were, doubtless, helped to their several peculiarities by such moulding influences as prevalent heat, or continuous cold, quietly stagnating peace, or the haste and hurry of war, and so forth. We can easily perceive how, in the course of ages, the common speech of any particular country, according to its climatic and social circumstances, would evolve as slow and sluggish, full as it were of frozen sounds, guttural or throat-words, and long-drawn utterance, instanced by Northern speech; or made up of rapid and fluent vocalization, as in the case of the Tropical South. In the lapse of time, these variations of speech thus adapted to particular localities, came to be fixed as the special tongue of such and such a people, which, while borrowing and interchanging continually from neighbouring tribes, would gradually harden into a greater unlikeness from the language of other distant tribes with whom they held no intercourse. Thus, then, we have arrived at a swift but comprehensive view of the thousand languages of mankind. Originally one, as still evidenced by similarity in alphabets, general construction of Grammar, and now and then by words common to them all, the many far-away tongues have become so diverse as to seem, at the extremes, utterly opposite; and even the more neighbouring tongues are so unlike to each other as to require special study for their attainment before any native can converse with a foreigner. We learn languages in order to hold intercourse with men of other countries, either by word of mouth or in writing, for kindly communion between man and man is the great end of all civilisation. Languages which are still spoken familiarly among nations of men are called living languages, and they are continually growing and changing like other living things; for instance, modern English has accumulated many words from other tongues, and has altered many of its own since the time not only of our early poet Chaucer, or more ancient Alfred, but even of King James: witness the terrible-looking words 'hell' and 'damnation,' which really mean only 'hole' or 'hiding-place,' and 'damnation' (*damnum*, Latin) for 'loss' or 'penalty.' It is very much to cure errors in our current—that is, living—language of Englishmen such as these, grown up in a couple of centuries, that the necessity, if not the wisdom, of a Biblical revision has come to be generally acknowledged.

Languages which have no nations now in existence numerically to speak of them, are called dead languages: they do not change; they are crystallized in manuscripts and books, or entombed on sculptured marbles. The Ninevite tablets are covered with an obsolete language, only just breaking the chain of death through the wonderful skill and acuteness of modern discoverers; Egyptian obelisks also have recently been interpreted, and many other monuments of hitherto unknown tongues, Etruscan, Phœnician, arrow- and nail-headed, and the like, are yielding up their secrets, as dead, yet speaking. But there are other languages that are 'dead, yet speaking,' of a vaster and wider character,—principally three, Hebrew, Greek, and Latin,—which also are styled the 'learned' languages as enshrining the wisdom of the wisest in all past time, and the 'classical' because so exact and well ordered as to resemble the ranks of a fleet of galleys (*classes*), or a troop of horse (*classis*); hence also, from their drilled arrangement, we call our school-detachments classes. The reasons why the world takes so much trouble to learn, and still to use, these old languages are many and various: as these amongst others,—first, the Greek and Roman writers—and we need scarcely add the Hebrew, above all, for these constitute the holy Jewish Scriptures—composed such admirable books in every variety of literature as to be worth our pains to read them in their original tongues; secondly, the structure of the languages themselves is of such a beautiful and exact fashion as, by the mere study of them, to educate the mind and improve the taste; thirdly, every living tongue—and our own

above all—is so mingled and incorporated with words from the dead languages as not to be well comprehensible without some knowledge of them; fourthly, seeing that the learned men of all countries know at least Latin and Greek, it follows that in these tongues we can converse with them, and understand books thus written by them in the phrases of antiquity; thus an Englishman, through adequate knowledge of his school-day classics (how few keep them up!), can hold intercourse intelligently with the scientific, not of Europe alone, as Russians or Turks, but also with all Asia, or the Bonzes of Buddha, the philosophers of Confutze, and others, the learned of every land; fifthly, and not to give further reasons, he that has mastered for himself the classical languages already has half learned many another civilised tongue, as Spanish, Italian, French, and their allies, so that his linguistic education may well be considered on a solid and broad foundation, if based upon the classics.

Let no man, therefore (even though he be an ex-Chancellor, and now a recent Peer of Parliament), despise the youthful acquisition of this generous and ennobling and enlarging sort of knowledge; in fact, it was the ladder whereby the eminent statesman in question raised himself to the top of the wall from which he so ungratefully kicked it in a too well remembered House of Commons speech, whereof, let us hope, he has since repented. And meanwhile, let us give our young scholars every encouragement to work on the old lines of Latin and Greek, although they may wisely add to such knowledge all manner of sciences and modern tongues.

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as strictly private—to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add together eighteen, eight hundred and thirty-two, six, eighty-seven, one thousand, and three hundred and ninety. Ans. 2333.

(2) From nine hundred and one take one hundred and ninety-two. Ans. 709.

(3) Take two thousand eight hundred and ninety-six from nine thousand five hundred and twelve. Ans. 6616.

STANDARD II.

(1) A man buys seven boxes of eggs, each box containing nine hundred and fifty. He finds that seventy-nine eggs are broken, how many has he to sell? Ans. 6571.

(2) Divide twenty-five thousand and seventy-three by nine. Ans. 2785 + 8.

(3) Multiply sixty-two thousand and forty-eight by nine hundred and eight. Ans. 56339584.

STANDARD III.

(1) Divide a million and three by five thousand three hundred and eighty-seven; then multiply the quotient (adding the remainder) by three thousand and ninety. Ans. 575058.

(2) From £18000, 0s. $9\frac{1}{2}$d. take £810, 0s. $11\frac{3}{4}$d. Ans. £17189, 19s. $9\frac{3}{4}$d.

(3) Add together £529, 16s. $5\frac{3}{4}$d., 89 shillings, 52 sixpences, 7 crowns, 39 farthings, eleven halfpence, 95 pence and seventeen fourpences. Ans. £538, 1s. 4d.

STANDARD IV.

(1) Multiply £37, 18s. $11\frac{1}{2}$d. by 690. Ans. £26184, 1s. 3d.

(2) How many bottles each containing a pint and a half can you fill from three barrels of beer? Ans. 576.

(3) Bring 5713607 ounces to tons. Ans. 159 tons 8 cwts. 1 qr. 16 lbs. 7 ozs.

(4) What is the cost of 3 tons 10 cwts. at a farthing a pound? Ans. £8, 3s. 4d.

STANDARD V.

(1) Find the rent of a house for 3 yrs. 7 months 2 wks. at fifty pounds per annum. Ans. £181, 5s.

(2) If a hundred pounds gain five pounds, what will nine pounds fifteen shillings gain? Ans. 9s. 9d.

(3) Find by practice the price of 913 chairs at £2, 16s. $10\frac{1}{2}$d. each. Ans. £2596, 6s. $10\frac{1}{2}$d.

(4) Make out in proper form and then settle the following butcher's bill:—14 lbs. beef at $10\frac{1}{2}$d. per lb., $21\frac{1}{2}$ lbs. mutton at 9d. per lb., $6\frac{1}{2}$ lbs. lamb at $11\frac{1}{2}$d. per lb., and half-a-dozen kidneys at 2s. 3d. a doz.

	£	s.	d.
Ans.	0	12	3
	0	16	$1\frac{1}{2}$
	0	6	$2\frac{3}{4}$
	0	1	$1\frac{1}{2}$
Total,	£1	15	$8\frac{3}{4}$

STANDARD VI.

(1) How many men in 12 days will do the work that 6 men can do in 14 days? Ans. 7 men.

(2) Simplify $\dfrac{5\frac{1}{3} \times 1\frac{1}{2}}{5\frac{1}{3} \div 1\frac{1}{2}}$. Ans. $2\frac{1}{4}$.

(3) From the sum of 4s. $3\frac{1}{5}$d. and 6s. $2\frac{2}{3}$d. take 7s. $1\frac{5}{12}$d. Ans. 3s. $4\frac{9}{20}$d.

(4) If 6·5 articles cost £1, 6s., what will 7·125 cost? Ans. £1, 8s. 6d.

Physiology.

(1) In what parts of the body are the most important organs?

(2) State which is the longest bone in the body.

(3) What is the chest called, and how is it divided from the abdomen?

(4) What is the function of the liver?

(5) What is the spleen?

(6) How is the heart divided?

(7) What is the work of the lungs?

(8) Why is tight-lacing bad for girls?

(9) Into how many parts is man's body divided?

(10) What is the sweet-bread?

(11) Explain the use of pancreatic juice.

(12) What tubes convey the blood to and from the heart?

Grammar.

STANDARD IV.

Parse:—No excuse of thoughtfulness will clear us from the wrong and sin of a broken promise.

STANDARDS V. AND VI.

(1) Analyse—(*a*) *To keep* a promise *is* a *duty binding* upon men of all ages, *ranks*, and all *conditions* of life.

(*b*) The sailors *heard* through the murky shroud
The *fog-bell sounding* its *warning* loud.

(2) Parse fully the words in italics.

(3) Write an account of your favourite game.

CLOUD AND SUNSHINE.

Words and Music by T. CRAMPTON.

Pupil Teacher's Examination Questions.

MARCH 1881.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. If the tax on £335, 7s. 6d. amounts to £58, 13s. 9¾d., what is that in the £?
2. Find wages of a housekeeper for 14 weeks 4 days 8 hours at 7s. 6d. per day, or at £136, 17s. 6d. per year (of 365 days).
3. Find the value of 718 yds. of tapestry at £2, 11s. 10½d. per yard.
4. A besieged town has provisions to last for 3 weeks. Its population is 22,400; how many people must be sent away in order that the provisions may last for 7 weeks?
5. If a 3 lb. loaf costs 7d. when wheat is at 52s. 6d. a quarter, what should be the price of wheat per quarter when 5½d. is charged for a 2 lb. loaf?

FEMALES.

1. Make out the following bill:—
   2 chests of tea, 110 lbs. each, at 2s. 3d. per lb.
   2 chests of tea, 101 lbs. each, at 3s. 11d. per lb.
   101 cwt. 14 lbs. of rice at 27s. 6d. per cwt.
   55 bags of coffee, each 1 cwt. 3 qrs., at 1s. 2½d. per lb.
   ½ ton of sugar at 2¾d. per lb.
2. Find by Practice the value of 5901 articles at £59, 16s. 8¾d. each.
3. What is the cost of 11513¾ articles at £9, 18s. 9d. each?
4. Find the value of 6 tons 16 cwt. 3 qrs. 20 lbs. at £56, 11s. 8d. per ton.

Grammar.

1. Parse all the nouns and verbs in the following:—

'Scarce were the piteous accents said,
When with the Baron's casque the maid
To the nigh streamlet ran:
Forgot were hatred, wrongs, and fears,
The plaintive voice alone she hears,
Sees but the dying man.'—SCOTT.

2. Some verbs have a nominative case after them as well as before them; of what kinds are they? Give examples.

Geography.

1. What is the nearest railway station to your home? By what lines of railway should you travel from it to go to Liverpool, Leeds, Oxford, and Plymouth? Trace in words the journey to *one* of these places as minutely as you can.
2. Write a letter, as from a boy going by sea from Aberdeen to London, describing what he had seen on the coast, supposing his ship to have been within sight of land all the way. *If you can*, draw a map of the coast in illustration.
3. Say what you know about the English and Irish lakes.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Burgundy*.

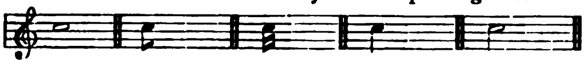
Write, in small hand, as a specimen of copy-setting, '*Yet here Prince Edward stands, King Henry's son.*'

Music.

A quarter of an hour allowed for this paper.

1. Write over each of the following notes its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other):—

2. Follow each of these notes by its corresponding rest:—



3. How many tones and semitones are found in a major scale, and what places therein do the latter occupy?

ANSWERS.—CANDIDATES.

Arithmetic.

MALES.

1.
£	s.	d		£	s.	d.		£
335	7	6	:	58	13	9¾	: :	1
20				20				
6707s.				1173s.				
12				12				
80490d.				14085d.				
4				4				
321960				56343				

$$\frac{£1 \times 56343}{321960} = \frac{1126860s.}{321960} = 3s.\ 6d.\ \text{Ans.}$$

2. (*a*) 14 wks. 4 dys. 8 hrs. at 7s. 6d. per day,
or 102⅓ days „ „
= 102s. 4d. × 7½ = (716s. 4d. + 51s. 2d.)
= 767s. 6d. = £38, 7s. 6d. Ans.

(*b*)
days		days		£	s.	d.
365	:	102⅓	: :	136	17	6
3		3		20		
1095		307		2737s.		
				12		
				32850d.		

$$\frac{32850d. \times 307}{1095} = 30 \times 307 = 9210d.$$
= 767s. 6d. = £38, 7s. 6d. Ans.

3.
	£	s.	d.	
	718	0	0	
			2	
	1436	0	0	= value of 718 at £2.
10s. = ½ of £1	359	0	0	= „ 10s.
1s. = $\frac{1}{10}$ of 10s.	35	18	0	= „ 1s.
6d. = ½ of 1s.	17	19	0	= „ 6d.
3d. = ½ of 6d.	8	19	6	= „ 3d.
1d. = ⅓ of 3d.	2	19	10	= „ 1d.
½d. = ½ of 1d.	0	14	11½	= „ ½d.
£	1861	11	3½	= value of 718 at £2, etc.

4. 7 wks. : 3 wks. : : 22,400 people.

$$\frac{22400 \times 3}{7} = 9600 \text{ people.}$$

∴ 12,800 people must be sent away.

5. 2 lbs. : 3 lbs : : 52s. 6d.
14 half-pence 11 half-pence

$$\frac{630d. \times 3 \times 11}{2 \times 14} = \frac{45 \times 3 \times 11}{2} = \frac{1485}{2} = 742\tfrac{1}{2}d.$$
= 61s. 10½d. Ans.

FEMALES.

1.
		£	s.	d.
2 chests of tea, 110 lbs. each	at 2s. 3d. per lb. =	24	15	0
2 chests of tea, 101 lbs. each	at 3s. 11d. per lb. =	39	11	2
101 cwts. 14 lbs. of rice	at 27s. 6d. per cwt. =	139	0	11¼
55 bags of coffee, each 1 cwt. 3 qrs.	at 1s. 2½d. per lb. =	651	5	10
½ ton of sugar	at 2¾d. per lb. =	12	16	8
	Total,	£867	9	7¼

2.
	£	s.	d.	
	5901	0	0	
			59	
	53109	0	0	
	29505	0	0	
	348159	0	0	= value of 5901 arts. at £59.
10s. = ½ of £1	2950	10	0	= „ 10s.
5s. = ½ of 10s.	1475	5	0	= „ 5s.
1s. = ⅕ of 5s.	295	1	0	= „ 1s.
6d. = ½ of 1s.	147	10	6	= „ 6d.
2d. = ⅓ of 6d.	49	3	6	= „ 2d.
¾d. = ⅛ of 6d.	18	8	9¾	= „ ¾d.
£	353094	18	9¾	= value of 5901 arts. at £59, etc.

3.

	£	s.	d.	
	11513	0	0	
			9	
	103617	0	0	= value of 11513 at £9.
10s. = $\frac{1}{2}$ of £1	5756	10	0	= ,, 10s.
5s. = $\frac{1}{2}$ of 10s.	2878	5	0	= ,, 5s.
2s. 6d. = $\frac{1}{2}$ of 5s.	1439	2	6	= ,, 2s. 6d.
1s. 3d. = $\frac{1}{2}$ of 2s. 6d.	719	11	3	= ,, 1s. 3d.
$\frac{3}{4}$ of £9, 18s. 9d.	7	9	$0\frac{3}{4}$	= value of $\frac{3}{4}$ at £9, 18s. 9d. each.
	£114417	17	$9\frac{3}{4}$	= value of $11513\frac{3}{4}$ at £9, 18s. 9d. each.

4.

	£	s.	d.	
	56	11	8	
			6	
	339	10	0	= value of 6 tons at £56, 11s. 8d. [per ton.
10 cwt. = $\frac{1}{2}$ ton	28	5	10	= ,, 10 cwt. ,, ,,
5 cwt. = $\frac{1}{2}$ of 10 cwt.	14	2	11	= ,, 5 cwt. ,, ,,
1 cwt. = $\frac{1}{5}$ of 5 cwt.	2	16	7	= ,, 1 cwt. ,, ,,
2 qrs. = $\frac{1}{2}$ of 1 cwt.	1	8	$3\frac{1}{2}$	= ,, 2 qrs. ,, ,,
1 qr. = $\frac{1}{2}$ of 2 qrs.	0	14	$1\frac{3}{4}$	= ,, 1 qr. ,, ,,
16 lb. = $\frac{1}{7}$ of 1 cwt.	0	8	1	= ,, 16 lb. ,, ,,
4 lb. = $\frac{1}{4}$ of 16 lbs.	0	2	$0\frac{1}{4}$	= ,, 4 lb. ,, ,,
	£387	7	$10\frac{1}{2}$	= value of 6 tons 16 cwt. 3 qrs. 10 lbs. at £56, 11s. 8d. per ton.

Grammar.

1. *were said*—verb, trans. pass. voice, strong conj. (*say, said, said*), indic. mood, past tense, 3d pers. plur. agr. with subj. *accents*.
   accents—noun, abstr. neut. plur. nom. subj. of *were said*.
   Baron's—noun, proper (in this instance), masc. sing. poss. attributive to *casque*.
   casque—noun, com. neut. sing. obj. gov. by *with*.
   maid—noun, com. fem. sing. nom. subj. of *ran*.
   streamlet—noun, com. neut. sing. obj. gov. by *to*.
   ran—verb intrans. strong conj. (*run, ran, run*), indic. mood, past tense, 3d pers. sing. agr. with subj. *maid*.
   were forgot—verb, trans. pass. voice, strong conj. (*forget, forgot, forgot* or *forgotten*), past tense, 3d pers. plur. agr. with subjs. *hatred, wrongs*, and *fears*.
   hatred—noun, abstr. neut. sing. nom. one of the subjs. of *were forgot*.
   wrongs—noun, abstr. neut. plur. nom. one of the subjs. of *were forgot*.
   fears—parsed same as *wrongs*.
   voice—noun, abstr. neut. sing. obj. of *hears*.
   hears—verb, trans. act. voice, strong conj. (*hear, heard, heard*), indic. mood, pres. tense, 3d pers. sing. agr. with subj. *she*.
   sees—verb, trans. act. voice, strong conj. (*see, saw, seen*), indic. mood, pres. tense, 3d pers. sing. agr. with subj. *she*.
   man—noun, com. masc. sing. obj. of *sees*.

2. The verbs which have a nominative case after them are passive verbs of *naming, making*, or *appointing*, etc., and such verbs as *be, become*. The nominative is complementary to or in apposition with the subject of the verbs; as, Thou art *the man*; John became *king*; He is named *John*; She was made *Empress of India*; I am appointed *enumerator*.

Geography.

1. The nearest station (*let us suppose*) is at Carlisle, and therefore to reach *Liverpool* we must travel by the London and North-Western to Wigan, where we branch off for our destination; to reach *Leeds* we go by the London and North-Western and the Midland; to reach *Oxford* we may take the London and North-Western to Crewe, and change to the Great Western going *viâ* Chester; to reach *Plymouth* we can go by the London and North-Western and Great Western to Exeter, and thence by the South Devon Railway.

In going from Carlisle to Liverpool we travel the entire counties of Cumberland, Westmoreland, and Lancashire. The most important towns on the route are Penrith, Kendal (the station for Windermere, etc.), Lancaster, with its old castle; Preston, Chorley, and Wigan (all three famous for cotton manufactures). The railway in the first part of the journey passes through a very uninviting district, chiefly lying among the moors between the Pennine Range and the Cumbrian Group. After passing Kendal the scenery improves, and in Lancashire we skirt Morecambe Bay, with the Irish Sea in the distance. From Chorley we pass into the vicinity of one of the wealthiest and most populous districts in England, and on arriving at Liverpool we have reached the outlet for the whole foreign trade of North-Western England, and above all for the cotton trade with America.

2. LONDON, *March* 26, 1881.

SIR,—In our voyage from Aberdeen, the Granite City, to London, I made the following notes on the coast features, etc. *Girdle Ness*, the extremity of the Grampians, is a short distance south of our starting-point; and from this, along the coasts of Mearns and Forfarshire, the coast is high and rugged. Passing *Buddon Ness*, we enter the *Frith of Tay*, on which stands *Dundee*, famous for linen and jute manufactures. Opposite the Frith stands the *Bell Rock*. Rounding *Fife Ness*, we enter the *Frith of Forth*, on the shores of which are many towns engaged in fisheries. On its southern shore is *Leith*, the port of *Edinburgh*. Both shores of the Forth are generally low, and the coast partakes of the same character till we reach *St. Abb's Head*, the eastern extremity of the Lammermuirs. That promontory rises 300 feet high, and bears the highest lighthouse on the east coast of Britain. Between St. Abb's and the Tweed, at the mouth of which stands *Berwick*, the coast is rocky and precipitous. From Berwick a sandy shore runs south to *Bamborough Castle*, on a lofty cliff, with the *Fern Isles* opposite, and *Holy Island* a little to the north. Passing *Coquet Island*, we reach *Tynemouth*, at the mouth of the Tyne. *Newcastle* is a great coal port; *North* and *South Shields* have considerable trade. *Sunderland*, at the mouth of the Wear, ranks next to Newcastle for coal. *Hartlepool*, on the north side of the estuary of the Tees, and *Stockton*, at the mouth of the same river, have considerable trade. *Middlesborough* is the centre of a flourishing iron district. The coast inclines now to the south-east to *Whitby*, near which is the birthplace of Captain Cook. *Scarborough* is a fashionable watering-place; and *Flamborough Head* is a most conspicuous headland, with *Bridlington Bay* on the south side of it. On rounding *Spurn Head* we pass the *Humber Mouth*, on which stands *Hull*, the third port in England. The coast of *Lincoln* is very low, so low in fact that the lantern on the top of the parish church of *Boston* is used as a lighthouse, and is visible forty miles off at sea. Along the Norfolk coast we pass *Lynn Regis* on the *Wash*, and *Hunstanton Cliff*, the termination of the East Anglian Chalk range. Proceeding east we come to *Cromer*, a fishing town, where the sea has gained greatly on the land. The coast now curves round to the Thames, and in many parts is much indented. *Yarmouth* is the great centre of the English herring fishery. *Lowestoft* is the most eastern point of England; and *Harwich* is one of the best ports on the east coast. Passing the *Naze*, we enter the Thames, with *Tilbury Fort* on the north side and *Gravesend* on the south. Then glancing at *Woolwich*, with its famous arsenal, and *Greenwich*, with its hospital and observatory, we finish our voyage at LONDON.

3. The chief peculiarity of the English lakes is that those of any consequence lie embosomed in the narrow valleys which are ranged round Helvellyn, the centre of the Cumbrian Group, and radiate outwards in all directions. The largest are Windermere, Haweswater, Ulleswater, Thirlemere, Derwentwater, Bassenthwaite Water, Buttermere, Crummock Water, Ennerdale Water, Wastwater, and Coniston Water.

The bulk of the Irish lakes, on the other hand, extend over one-half of the island, that half lying to the north-west of a line drawn from Belfast Lough to Kenmare Bay. They differ from the English lakes in forming long chains of water joined by rivers instead of radiating from a centre. The chief lakes are Lough Neagh, the Lakes on the Erne, the Lakes on the Shannon, viz. Loughs Allen, Rea, and Derg; the Lakes of Connemara—Lough Mask and Lough Corrib, connected by an underground channel; and the Upper, Middle, and Lower Lakes of Killarney, noted for their beautiful scenery.

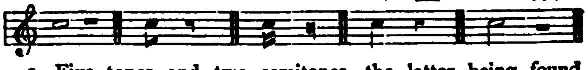
Music.

1.

A D D G A

Minim. Crotchet. Quaver. Semibreve. Semiquaver.

2.



3. Five tones and two semitones, the latter being found between the 3d and 4th and 7th and 8th notes of the major scale.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What is a *decimal* fraction? Find the *sum* and *difference* of $\cdot\dot{3}6\dot{7}$ and $\cdot 04\dot{5}\dot{2}$; express it in decimals. What sort of fractions are these?

2. Reduce $3\frac{5}{9}$ of £1, 0s. $9\frac{3}{4}$d. to the fraction of £1, 10s. 10d.

3. Express 17 days 6 hours in the decimal of a year of $365\frac{1}{4}$ days. (5 places of decimals.)

4. Multiply $3\frac{3}{20}$ by $15\frac{5}{7}$, and divide $\frac{2}{3\frac{3}{4}}$ by $\frac{2\frac{3}{4}}{3}$, and add together the *sum* and *difference* of these results.

5. The year consists of 365 days 5 hours 48 minutes $47\frac{1}{2}$ seconds. By the system of leap years, a day is added every fourth year. What decimal fraction of a day too much is thus added?

FEMALES.

1. A man buys 148 yards of cloth at 2s. $7\frac{1}{2}$d. per yard. At what price per yard must he sell it to gain £12, 12s. 10d. by the whole?

2. The sum of £231, 18s. is to be raised in a parish, the rateable value of which is £6184. What is the rate in the £?

3. If 4 men earn £7, 10s. in 10 days, how many men will earn 10 guineas in 7 days?

4. An iron beam 16 feet long, $2\frac{1}{2}$ feet broad, and 8 inches thick, weighs 1280 lbs.; what must be the length of a beam whose breadth is $3\frac{3}{4}$ ft., thickness $7\frac{1}{2}$ in., and weight 2028 lbs.?

Grammar.

1. Point out and parse the pronouns and prepositions in the following:—

(*a*) 'The poorest poor
Long for some moments in a weary life
When they can know that they have been
Themselves the fathers and the dealers out
Of some small blessings, have been kind to such
As needed kindness, for this single cause
That we have all of us one human heart.'

WORDSWORTH.

(*b*) Show that the word 'that' in the above is not a pronoun.

2. Adjectives are sometimes used as adverbs. Give examples of this, and show how you can decide in case of doubt whether a word is really an adverb or an adjective.

Geography.

Answer either Question 1 or Question 3, *not both*.

1. What is the nearest railway station to your home? By what lines of railway should you travel from it to go to Liverpool, Leeds, Oxford, and Plymouth? Trace minutely in words the journey to one of these places.

2. Draw a map of the coast from the mouth of the Po to the Dardanelles, marking capes, bays, river-mouths, islands, and seaports.

3. Describe fully, as to children, the chief objects of interest to a traveller in Holland and Belgium.

History.

1. Give the dates of Alfred, Canute, and Edward the Confessor, and name their immediate predecessors.

2. Give the dates of Stephen, John, and Elizabeth; and name their immediate successors.

3. Give the names and dates of our sovereigns from James II. to Victoria.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Burgundy*.

Write, in small hand, as a specimen of copy-setting, '*Yet here Prince Edward stands, King Henry's son.*'

Composition.

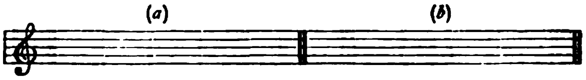
Write from memory the substance of the passage read to you by the Inspector.

Music.

A quarter of an hour allowed for this paper.

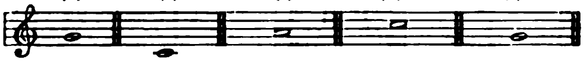
1. Write in (*a*) the scale of A (*La*), and in (*b*) the scale of E♭ (*Me*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

(*a*) (*b*)



2. Place its third over (*a*), its fifth over (*b*), its fourth over (*c*), its second over (*d*), and its seventh over (*e*).

(*a*) (*b*) (*c*) (*d*) (*e*)



3. How many crotchets are equal (in length) to one semibreve?
How many quavers are equal (in length) to one dotted minim?
How many minims are equal (in length) to one semibreve?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. A '*decimal*' (from *decimus*, tenth) fraction is one whose denominator is 10 or any power of 10, as $\frac{3}{10}$, $\frac{3}{100}$, $\frac{3}{1000}$, which are usually written ·3, ·03, ·003, a figure being cut off by the point for every power of 10 in the denominator.

Sum.	*Difference.*
$\cdot 36\dot{7}36736$	$\cdot 36\dot{7}36736$
$\cdot 04\dot{5}\dot{2}5252$	$\cdot 04\dot{5}\dot{2}5252$
$\cdot 41\dot{2}6198\dot{9}$	$\cdot 32\dot{2}1148\dot{4}$

The first fraction is a pure circulating decimal, and the second a mixed circulating decimal.

2. $$\frac{3\frac{5}{9}\text{ of £1, 0s. }9\frac{3}{4}\text{d.}}{\text{£1, 10s. 10d.}}=\frac{32\times 249\frac{3}{4}\text{d.}}{9\times 370\text{d.}}$$
$$=\frac{32\times 999}{9\times 370\times 4}=\frac{8\times 111}{370}=\frac{24}{10}=\frac{12}{5}.\text{ Ans.}$$

3. $$\frac{17\frac{1}{4}}{365\frac{1}{4}}\text{ days}=\frac{69}{1461}=$$

```
1461)69·00(·04722 . . . Ans.
     5844
     ----
     10560
     10227
     -----
      3330
      2922
      ----
      4080
      2922
```

4. (*a*) $\frac{63}{20}\times\frac{110}{7}=\frac{99}{2}=49\frac{1}{2}$. Ans.

(*b*) $\frac{8}{15}\div\frac{11}{12}=\frac{8\times 12}{15\times 11}=\frac{32}{55}$. Ans.

(*c*) Sum of answers to (*a*) and (*b*) $=49\frac{55}{110}+\frac{64}{110}=50\frac{9}{110}$. Ans.

(*d*) Difference of answers to (*a*) and (*b*) $=48\frac{101}{110}$. Ans.

Therefore sum of answers to (*c*) and (*d*) = 99

5. One day added every fourth year is equivalent to 6 hours every year, or 11 minutes $12\frac{1}{2}$ seconds too much every year; so by the end of the fourth year, 44 minutes 50 seconds have been added, or

$$\frac{44\text{ min. }50\text{ sec.}}{24\text{ hrs.}}=\frac{2690\text{ sec.}}{1440\text{ min.}}=\frac{2690}{86400}\text{ sec.}$$

$$=\frac{269}{9\times 12\times 8\times 10}=8)26\cdot 9$$

```
12)3·3625
 9)·2802083
   ·031134259 of 1 day. Ans.
```

FEMALES.

1. The gain on every yard × 148 = £12, 12s. 10d.
,, ,, ,, = £12, 12s. 10d. ÷ 148.
,, ,, ,, ,, $= \frac{252\text{s. } 10\text{d.}}{148}$.
,, ,, ,, ,, = 1s. 8½d.;
∴ he must sell 1 yard for 4s. 4d. Ans.

2.
$$\begin{array}{rcrcr} \pounds & & \pounds \quad s. & & \pounds \\ 6184 & : & 231 \quad 18 & : & 1 \\ 20 & & 20 & & \\ \hline 123680\text{s.} & & 4638\text{s.} & & \\ & & 20 & & \\ \hline & & 92760 & & \\ & & 12 & & \\ \hline \end{array}$$
123680)1113120(9d. Ans.
)1113120(

3.
£7½ : £10½ :: 4 men
7 : 10
$$\frac{4 \times 21 \times 10}{15 \times 7} = 8 \text{ men. Ans.}$$

4.
3¼ ft. : 2¼ ft. :: 16 ft.
7½ in. : 8 in.
1280 lbs. : 2028 lbs.
$$\frac{16 \text{ ft.} \times 9 \times 16 \times 2028}{13 \times 15 \times 1280} = \frac{9 \times 2028}{13 \times 15 \times 5} = \frac{3 \times 156}{25}$$
$$= 18\frac{18}{25} \text{ ft. Ans.}$$

Grammar.

1. (*a*)
for—prep. (forming part of the verb *long for*) gov. *moments* in obj. case.
in—prep. governing obj. case *life*.
they—pron., simple, person. refers to *poor*, 3d pers. masc. gender, plu. nom. subj. to *can know*.
they—*same as preceding*, subj. to *have been*.
themselves—comp. pers. pron. emphatic, 3d pers. masc. plu. nom. after *have been* (in apposition with subj. *they*).
of—prep. governing obj. case *blessings*.
to—prep. gov. obj. case *such*.
such—indef. pron. com. gen. plu. obj. gov. by *to*.
as—relative pron., refers to *such*, com. gen. plu. nom. subj. to *needed*.
for—prep. governing obj. case *cause*.
we—1st pers. pron., used indefinitely, com. gen. plu. nom. subj. to *have*.
all—indef. pron., refers to *we*, with which it agrees.
of—prep. governing obj. case *us*.
us—1st pers. pron. indefinite com. gen. obj. gov. by *of*.

(*b*) If *that* were a relative pronoun, it could be changed to *who* or *which* without injuring the sense of the passage; and if it were a demonstrative pronoun, it would point out some noun understood. Here it does not answer to either of these tests.

2. Some adjectives have the same form as adverbs, as, The sun shines *bright*; to hit *hard*; *pretty* well; to aim *high*; to speak *loud*. In case of doubt, try whether the word modifies the meaning of the verb or qualifies the noun.

Geography.

1. *See same question answered under Candidates in this number of Magazine.*

3. NOTES ON HOLLAND AND BELGIUM.

General Appearance of the two Countries.—A general idea of the surface may be obtained by considering the two countries as an inclined plane, rugged and elevated in the south-east, whence it slopes to the west and north, sinking into plains lower than the sea-level. Only two of the Belgian streams—the Meuse and the Scheldt—deserve the name of rivers, but they supply a most abundant water communication. Holland (or the Netherlands) has been reclaimed from the sea; evidence of this is shown from the salt-water deposits. The sea is prevented from inundating the country by dykes, which also protect portions of land from lakes and rivers. The lands enclosed by these dykes are called Polders, and are drained by windmills, which form a characteristic feature of a Dutch landscape. Canals both in Belgium and Holland form an important means of inter-communication, and in the latter they are used as the principal means of communication. Every little village has its canals, and every large town is intersected by them. The Rhine is the chief river of Holland, entering the sea through a number of arms and sluggish winding channels; and the hills of the Netherlands are merely heights of sand forming a barren line along a portion of the coast.

Agriculture.—The greater part of Belgium is not naturally fertile, but the industry of the people has rendered the soil highly productive. Spade-husbandry is extensively employed, and great attention is paid to the rotation of crops. Flax, hemp, and tobacco are grown, and in the western part of Flanders cows are kept in great numbers. Flemish horses are interesting from the value set upon them. Holland is more of a grazing than an arable country, and great attention is paid to the rearing of live stock and the produce of the dairy. Oxen thrive well in the rich polders of the country. Immense quantities of butter and cheese are exported. The other products resemble those of Belgium.

Interesting Manufactures.—Lace, at Brussels and Mechlin. Ironworks along the banks of the Meuse; Liége is the centre. Namur is noted for its fine cutlery. The linen of Flanders is widely known. At Utrecht and Leyden large manufactures of tiles and bricks are carried on. The making of wooden clocks forms a characteristic branch of Dutch industry. Geneva or Hollands is extensively made at Schiedam. Shipbuilding is another great branch of the industrial pursuits of Holland.

Interesting Places.—*Brussels*—handsome; several fine cathedrals; ten miles south is the battle-field of Waterloo. *Antwerp*—great emporium of Belgian commerce; its beautiful Gothic cathedral much admired. Many of the cities of Belgium possess fine cathedrals, richly adorned with works of art. Belgium has been called the battle-field of modern Europe, from the number of battles which have been fought on its soil. *Amsterdam*—the largest city in Holland; intersected by numerous canals; 290 bridges; its vast shipbuilding yards and magazines of marine stores are very striking. *The Hague* is one of the best-built cities of Europe, and the seat of the Government. *Ryswick*—famous for its treaty, 1697. *Leyden*—famed for its university.

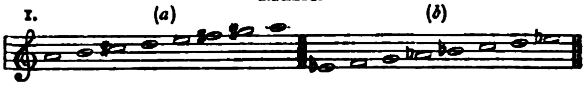
History.

		A.D.		
1.	Alfred began to reign	871;	succeeded	Æthelred I.
	Canute ,,	1017;	,,	Edmund Ironside.
	Edward the Confessor ,,	1042;	,,	Hardicanute.
2.	Stephen began to reign	1135;	succeeded by	Henry II.
	John ,,	1199;	,,	Henry III.
	Elizabeth ,,	1558;	,,	James I.

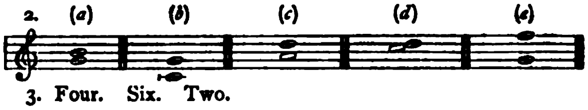
			A.D.
3.	James II. began to reign		1685.
	William III. and Mary II. began to reign	,,	1688.
	Anne	,, ,,	1702.
	George I.	,, ,,	1714.
	George II.	,, ,,	1720.
	George III.	,, ,,	1760.
	George IV.	,, ,,	1820.
	William IV.	,, ,,	1830.
	Victoria	,, ,,	1837.

Music.

1. (*a*) (*b*)



2. (*a*) (*b*) (*c*) (*d*) (*e*)



3. Four. Six. Two.

SECOND YEAR.

Pupil Teachers at end of Second Year, *if apprenticed on, or after, 1st May* 1878; and Pupil Teachers at end of Third Year, if apprenticed before that date.

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What is meant by 'interest'? Find the simple interest on £2275 for 3½ years at 5 per cent. per annum.

2. A merchant lost 25 per cent. in selling goods which he had bought for £9, but at the same time gained 45 per cent. on an article which cost £12, 10s. How did his account then stand?

3. A has a third part of £9, 17s. $6\frac{3}{4}$d.; B has half of seven times 17s. $10\frac{1}{2}$d.; and C has a year's interest of £80 at $3\frac{3}{4}$ per cent. What is the difference between the highest and the lowest sum of the three?

4. Selling a pistol for 19s., I lost 5 per cent. What should it have been sold for to gain $12\frac{1}{2}$ per cent.?

5. At what rate per cent. will a man receive interest who invests his money in the 3 per cents. standing at $89\frac{7}{8}$, commission being $\frac{1}{8}$ per cent.?

FEMALES.

1. How much does the difference of $5\frac{23}{32}$ and $2\frac{2}{7}$ exceed the sum of $\frac{5}{8}+\frac{5}{14}+\frac{1}{6}$?

2. Divide $\frac{3}{4}$ of $\frac{7}{8}$ by $\frac{15}{16}$ of 7.

3. Reduce to its simplest form $\dfrac{\frac{10}{3}+\frac{5}{6}-\frac{20}{21}}{\frac{5}{6}-\frac{4}{7}}$.

4. If I pay away $\frac{1}{3}$ of my money, then $\frac{1}{2}$ of what remains, and then $\frac{1}{4}$ of what still remains, what fraction of the whole will be left?

Grammar.

1. What are corresponding conjunctions? Why so called? Give examples of their use.

2. Point out and analyse the adjective sentences in the following, and show that they are adjective sentences:—

(*a*) 'I muse on joys that will not cease,
Pure spaces clothed in living beams,
Pure lilies of eternal peace,
Whose odours haunt my dreams.'—TENNYSON.

(*b*) Parse the pronouns and verbs in the above passage.

Geography.

Answer either Question 1 or Question 2, *not both.*

1. Give notes of a lesson on 'The chief objects of interest to a traveller in Holland and Belgium.'

2. Describe fully the physical features and general character of Jamaica, Vancouver's Island, British Guiana, the Mackenzie River, and Quebec.

3. Describe fully a coasting voyage round Australia. Draw a map in illustration.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. To what race did the earliest inhabitants of Britain belong? In what countries do we now find descendants of that race?

2. Mention the names and dates of historical persons connected with the introduction of Christianity in Ireland, Scotland, Canterbury, and York.

3. What events of the thirteenth century show that the power and influence of both nobles and commons were advancing at that period?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Burgundy.*

Write, in small hand, as a specimen of copy-setting, '*Yet here Prince Edward stands, King Henry's son.*'

Composition.

Write full notes of a lesson on *The Camel.*

Euclid.

[All generally-understood abbreviations for *words* may be used, but no symbols of *operations,* such as —, +, × are admissible.]

1. If two triangles have two sides of the one equal to two sides of the other, each to each, and have likewise their bases equal, the angle which is contained by the two sides of the one shall be equal to the angle contained by the two sides equal to them of the other.

What is the converse proposition? Is it true?

2. Any two sides of a triangle are together greater than the third side.

The sum of the distances of any point from the angles of a quadrilateral is greater than half the sum of the sides.

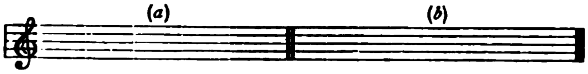
Music.

A quarter of an hour allowed for this paper.

1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms:—

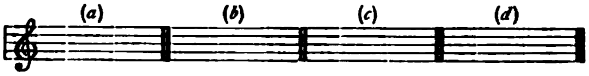
2. Write in (*a*) two measures of common time, and in (*b*) two measures of triple time.

(*a*) (*b*)



3. Write in (*a*) the signature of G (*Sol*), in (*b*) that of F (*Fa*), in (*c*) that of D (*Re*), and in (*d*) that of B♭ (*Se*).

(*a*) (*b*) (*c*) (*d*)



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. 'Interest' means money given for the loan of money. Interest of £2275 for $3\frac{1}{2}$ years at 5 p. c.

$$=\frac{£2275\times3\frac{1}{2}\times5}{100}=\frac{15925}{40}=£398,\ 2s.\ 6d.$$

2. (*a*) 25 p. c. loss on £9 = $\frac{1}{4}$ of £9 = £2, 5s. loss.

(*b*) 45 p. c. gain on £12, 10s. = $\frac{45}{100}$ of 250s.
= £5, 12s. 6d. gain;

∴ he has a total gain of £5, 12s. 6d. — £2, 5s., or £3, 7s. 6d. on the £21, 10s.

3.

	£	s.	d.
$\frac{1}{3}$ of £9, 17s. $6\frac{3}{4}$d. =	3	5	$10\frac{1}{4}$
$\frac{7}{2}$ of 17s. $10\frac{1}{2}$d. =	3	2	$6\frac{3}{4}$
£80 at $3\frac{3}{4}$ p. c. =	3	0	0
∴ the difference between the greatest and least =	0	5	$10\frac{1}{4}$ Ans.

4. Stating this sum briefly,

95 : $112\frac{1}{2}$: : 19s. : new selling price.

$$\frac{19s.\times112\frac{1}{2}}{95}=22s.\ 6d.\ \text{Ans.}$$

5. For £100 stock he pays $89\frac{7}{8}+\frac{1}{8}$ or £90.
£90 brings him £3, and so he will receive interest at the rate

$$\frac{£3\times100}{90}=3\tfrac{1}{3}\ \text{p.c.}$$

FEMALES.

1. (*a*) $5\frac{23}{32}-2\frac{2}{7}=5\frac{161}{224}-2\frac{64}{224}=3\frac{97}{224}=3\frac{291}{672}$.

(*b*) $\frac{5}{8}+\frac{5}{14}+\frac{1}{6}=\frac{105+60+28}{168}=1\frac{25}{168}=1\frac{100}{672}$

∴ (*a*) exceeds (*b*) by $2\frac{191}{672}$. Ans.

2. $\left(\frac{3}{4}\text{ of }\frac{7}{8}\right)\div\left(\frac{15}{16}\text{ of }\frac{7}{1}\right)=\frac{3\times7\times16\times1}{4\times8\times15\times7}=\frac{1}{10}$ Ans.

3. $$\frac{\frac{10}{3}+\frac{5}{6}-\frac{20}{21}}{\frac{5}{6}-\frac{4}{7}}=\frac{\frac{140+35-40}{42}}{\frac{35-24}{42}}=\frac{135}{42}\div\frac{11}{42}=\frac{135\times42}{42\times11}$$

$=12\frac{3}{11}$. Ans.

4. After paying away $\frac{1}{3}$ I have $\frac{2}{3}$ left.
$\frac{1}{2}$ of $\frac{2}{3}=\frac{1}{3}$, $\frac{1}{4}$ of the remaining $\frac{1}{3}=\frac{1}{12}$.
$\frac{1}{3}-\frac{1}{12}=\frac{1}{4}$ of whole.

Grammar.

1. Some conjunctions go in pairs, the first one preparing the way for the other and corresponding with it, hence the origin of the name, as:—

Either . . .	or.
neither . .	nor.
although . .	yet.
though . .	still.
notwithstanding .	nevertheless.
as . . .	so.
because . .	therefore.

Examples.—*Either* you *or* I must go; he *neither* writes *nor* reads; *though* I heard it, *yet* I cannot believe it.

2. (*a*) ADJECTIVE SENTENCES.

Sentences.	Subject.	Predicate.	Object.
(1) That will not cease, *qualifying* 'joys.'	That	will not cease	...
(2) Whose odours haunt my dreams, *qualifying* 'lilies.'	whose odours	haunt	my dreams

These are called adjective sentences because they qualify nouns like simple adjectives.

(*b*) PARSING.

I—pers. pron. 1st. pers. com. gen. sing. nom. subj. to *muse*.
muse—verb, intrans. (compounded with *on*, trans.), weak conj. indic. pres. 1st pers. sing. agr. with *I*.
that—rel. pron. neut. plur. nom. refers to antecedent 'joys,' subj. to verb *will cease*.
will cease—verb, intrans. weak conj. indic. future, 3d pers. plur. agr. with subj. *that*.
clothed—verb, intrans. (with *in* trans.), both weak and strong conj. (*clothe*, *clad*, *clad*), complete part. belonging to *spaces*.
whose—rel. pron. (for *of which*), neut. plur. refers to lilies, poss. attributive to *odours*.
haunt—verb, trans. weak conj. indic. pres. 3d pers. plur. agr. with subj. *odours*.
my—poss. adj. pron. (or a form of *mine*, and therefore poss. case of *I*), attributive to *dreams*.

Geography.

1. *See same answered under First Year in this number of Magazine.*

2. *Jamaica.*—By far the greater part of the island is covered with wild wood and jungle. The most striking features are on the north, gentle hills and vales covered with rich verdure, and on the south abrupt precipices and inaccessible cliffs, over which streams frequently project themselves into the sea. The only range of mountains is the Blue Mountains, and the only navigable stream is the Black River. Not more than half the surface is level.

Vancouver's Island.—So far as this island has been explored, the centre of the country is said to be a mass of rock and mountain. The country is diversified by mountain, precipice, hill, dale, and lake, and the whole surface is more or less densely wooded. The soil is in many parts remarkably rich, and possesses luxuriant vegetation. The coast is much indented, and coal has been found of a most excellent quality.

British Guiana.—The whole of the northern part is a low, flat region, scarcely raised above the level of the sea, and in some parts even below it, and has been formed of the mud brought down by the Amazon and other rivers. The southern half rises in a series of terraces towards the interior. The present cultivated districts lie either on the sea-coast or along the river-sides.

Mackenzie River.—Rising in the Rocky Mountains under the name of the Athabasca, it flows into Athabasca Lake. Before entering the lake it makes its way through a narrow gorge bounded by lofty mountains. After leaving the lake, it has a breadth of from one to three miles, except where it is narrowed from the nature of the ground. It is swollen by the Turnagain, and a stream from Great Bear Lake, and enters the Arctic Ocean by a delta forty miles broad. The basin of this river is for the most part covered with grassy plains, and the bed of the river is for some distance fringed with trees, but they soon become stunted and straggling.

Quebec.—This city stands on a very small promontory on the left bank of the St. Lawrence, a little below the junction of the Chaudiere. There is perhaps no city in the world more striking in appearance. Its fortress is, next to Gibraltar, the strongest that exists.

3. A VOYAGE ROUND AUSTRALIA.

Leaving Sydney on the south side of Port Jackson, which is one of the finest harbours in the world, and passing Botany Bay and Cape Howe, we arrive at the coast of Victoria, the most flourishing of the Australian Colonies. Melbourne is the capital of Victoria, and stands on the Yarra Yarra. The channel between Victoria and Van Diemen's Land is called Bass's Strait, rather dangerous for navigation. The island of Van Diemen's Land, or Tasmania, has an area of 24,000 square miles. The coasts are in many parts steep and rocky. Hobart Town is the capital. We now reach the shores of South Australia, which lies west of Victoria. It is exceedingly productive of minerals, especially copper and lead. Proceeding north-west we arrive at Adelaide, the capital of the colony. It stands on an inlet of Spencer Gulf, at the entrance of which is Kangaroo Island. Passing Spencer Gulf, there is nothing of any importance till we come to West Australia, established 1829. Freemantle is its port, but Perth, farther inland, is the capital. Continuing northward, we pass the north-west cape, and inclining to the north-east, come to Van Diemen's Gulf, which is land-locked by the islands of Bathurst and Melville and Coburg Peninsula. We are now at North Australia, which has no government settlement at present. We now reach the Gulf of Carpentaria, the largest inlet on the Australian coast. Torres Strait, which separates Australia from New Guinea, is about ninety miles wide, and very dangerous to navigation. Here is Cape York, the most northerly point of the island-continent, and as there is nothing of any consequence, we proceed to Moreton Bay. This district promises to become an important agricultural settlement. In 1859 this district was formed into a colony under the name of Queensland. The chief town is Brisbane. We now arrive at New South Wales. This colony is bounded on the north by Queensland, and on the south by Victoria. Sheep-grazing is carried on to a great extent, and the chief exports are wool and tallow. After passing the thriving settlement of Port Macquarie, we come to Newcastle, with its coal mines, and then to Sydney, thus finishing the voyage round the island.

History.

1. The earliest inhabitants of Britain belonged to the Celtic race. We find descendants of that race in the Highlands of Scotland, in Wales, and Cornwall, in the west of Ireland, and in Brittany in France.

2. Tradition says that *St. Patrick* was connected with the introduction of Christianity into Ireland in the *fifth* century; and *St. Columba* carried the gospel to Scotland in the *sixth* century, and founded the monastery of Iona. *St. Augustine* was the first archbishop of Canterbury about the year 600, having obtained a church in that town from Æthelbert, king of Kent, himself a convert to Christianity. Edwin, king of Northumbria, after his conversion founded the Minster of York, which was at first a simple wooden church (627).

3. There are three important events in the thirteenth century which show that the power of the nobles and Commons was advancing, viz. the compelling of King John to sign *Magna Charta* in 1215, the *Provisions of Oxford* (1258), and *Simon de Montfort's Parliament* (1265).

NOTES ON THE CAMEL.

Classification.—Backboned, mammal, a cud-chewer.

Structure.—Bigger than a horse—seven or eight feet high—rough hair—large hump when animal is fat—small hump when lean—shape of body an arch—long slender legs—soft, spongy feet—broad to prevent it sinking in sand—long neck—head small—nostrils able to close to keep out drifting sand—peculiar stomach.

Habits.—Can walk over soft sand without feeling tired—needs little water—very patient—kneels to be loaded and unloaded—food—some prickly shrubs, date leaves, and beans.

Where he lives (*habitat*). — Arabia, Africa, South-eastern Europe.

Uses.—Arab rides on camel—carries burdens—milk and flesh used for food—hair made into cloth for clothes and tents—leather, made of its skin, for saddle-belts and water-bottles.

Euclid.

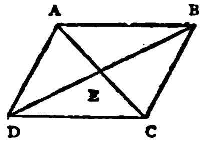
1. Prop. 8, Book I.

The converse proposition is:—*If two triangles have two sides*

of the one respectively equal to two sides of the other, and the angles contained by those sides equal to each other, then the bases or third sides shall be equal (Prop. 4, Book I. shows the truth of this).

2. Prop. 20, Book I.

Rider.—Let ABCD be any quadrilateral, and E any point within it. Then the sum of the distances EA, EB, EC, ED is greater than the sum of the sides AB, BC, CD, DA.



Since BE, EC are greater than BC; EC, ED greater than DC; ED, EA greater than DA; then twice EB, twice EC, twice ED, and twice EA together are greater than the sum of BC, CD, DA, and AB, or, halving these, the sum of EB, EC, ED, and EA is greater than half the sum of BC, CD, DA, and AB. —Q.E.D.

Music.

1.

Perfect 4th. Perfect 5th. Major 3d. Major 7th. Minor 2d.

2. (*a*) (*b*)

3. (*a*) (*b*) (*c*) (*d*)

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May* 1878; **and Pupil Teachers at end of Fourth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. How much must I invest in the 3 per cents. standing at $94\frac{1}{4}$, in order to have an income of £75, 5s. od. per annum?

2. Five per cent. on a certain sum yields £3·75; find ·125 per cent. on the same sum in £ *s. d.*

3. Divide £426 among 3 persons, A, B, and C, so that their shares shall be as $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$.

4. Find the mercantile discount on £100 due in 73 days at 4 per cent.

5. Find the difference between the simple and the compound interest on £1000 for 3 years at 5 per cent.

FEMALES.

1. Divide ·011214 by 53·4, and prove the result by vulgar fractions.

2. Simplify $2\frac{1}{4}+72\frac{3}{8}+316\frac{1}{4}+2·875$.

3. A man walked in 4 days 60 miles; in each of the three first days he walked an equal distance, in the fourth day he walked 13·95 miles; find the amount of his daily walking.

4. A person has ·1875 of a mine; he sells ·17 part of his share; what fractional part of the mine has he left?

Grammar.

1. 'Lustily
I dipped my oars into the silent lake;
And, *as* I rose upon the stroke, my boat
Went *heaving* through the water *like a swan;*
When from *behind* that craggy steep, *till then*
The horizon's *bound*, a huge peak, black and huge,
As if with voluntary power *instinct*,
Upreared its head.'—WORDSWORTH.

(*a*) What is an adverbial phrase? distinguish it from an adverbial sentence, and give examples of both from the above passage.

(*b*) Parse the words in italics.

(*c*) Give the meaning of the above passage in your own words.

2. Point out the prefix and give its meaning in the following words:—Avaunt, abdicate, avert, acquaint, achieve, adventure, accuse.

Geography.

Answer either Question 2 or Question 3, *not both.*

1. Give full notes of a lesson on the following sentence in a letter from a young man who is intending to settle somewhere in Australia:—

'I have just returned to Sydney from a voyage round this vast island, in which I have seen every part of the coast, and have examined each of our settlements.'

Draw a map in illustration.

2. Describe a journey by land from the mountains of Abyssinia to Jerusalem.

3. Name, in order, the rivers of Asia, flowing into the Pacific and Arctic Oceans. Describe briefly the source and course of each.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. What explanation would you suggest of the fact that the power of Henry VIII. was more absolute than that of other English kings?

2. Contrast the character of James I. with that of his immediate predecessor on the throne.

3. When and by whom was the battle of Plassey fought? Give some account of the rise and progress of the British Empire in India.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Burgundy.*

Write, in small hand, as a specimen of copy-setting, '*Yet here Prince Edward stands, King Henry's son.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operations*, such as —, +, ×, are inadmissible.]

1. Straight lines which are parallel to the same straight line are parallel to each other.

If two adjacent sides of a parallelogram be parallel to two adjacent sides of another parallelogram, the other sides will also be parallel.

2. If the square described upon one of the sides of a triangle be equal to the squares described upon the other two sides of it, the angle contained by these two sides is a right angle.

What is the converse proposition?

Algebra.

1. Show that $1+x(x+1)(x+2)(x+3)=(x^2+3x+1)^2$.

2. Prove that the L. C. M. of two expressions is their product divided by their G. C. M.

Find the L. C. M. of $2x^2-7x-2$ and $2x^2-x-6$.

3. Solve the equations:—

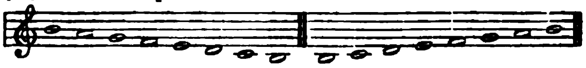
$$(1)\quad \frac{x}{2}-\frac{5x+4}{3}=-\frac{9-4x}{3}.$$

$$(2)\quad \frac{4+3x}{1+2x}-\frac{1}{2}=\frac{x+19}{x+12}.$$

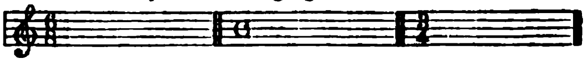
Music.

A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of B (*Si*). Mark the places of the semitones:—



2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures:—



3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature:—

ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. If £94¼ bring an income of £3, what investment will bring £75¼?

$$£3 : £75\tfrac{1}{4} :: £94\tfrac{1}{4}.$$

$$\frac{94\frac{1}{4}\times 75\frac{1}{4}}{3} = £\frac{377\times 301}{48} = £\frac{113477}{48} = £2364,\ 2s.\ 1d.$$

2. If £100 gives £5, what sum gives £3·73?

£5 is derived from £100,
£1 „ £20,
£3·75 „ 20 × 3·75
£75.

And ·125 per cent. of $£75 = \frac{·125}{100}$ of £75
$= £\frac{1}{8} \times \frac{75}{100} = 2s.\ 6d. \times \frac{3}{4} = 1s.\ 10\frac{1}{2}d.$ Ans.

3. $\frac{1}{3}+\frac{1}{5}+\frac{1}{7} = \frac{35}{105}+\frac{21}{105}+\frac{15}{105} = \frac{71}{105}$;

£ £
∴ 71 : 35 :: 426 : 210, first share.
71 : 21 :: 426 : 126, second „
71 : 15 :: 426 : 90, third „

4. Interest on £100 for $\frac{1}{5}$ year $= £4 \times \frac{1}{5} = £\frac{4}{5}$;
∴ £100 would increase to $£100\frac{4}{5}$.
So that discount on $£100\frac{4}{5} = £\frac{4}{5}$,

$$„\quad £1 = £\frac{\frac{4}{5}}{100\frac{4}{5}},$$

$$„\quad £100 = £\frac{\frac{4}{5}\times 100}{\frac{504}{5}},$$

$$„\quad „ = £\frac{80\times 5}{504},$$

$$„\quad „ = 15s.\ 10\tfrac{10}{21}d.$$

5. (1) Simple interest $= £\frac{1000\times 3\times 5}{100} = £150.$

(2) Principal for 1st year = £1000;
∴ interest „ $= £1000 \times \frac{5}{100} = £50.$
Principal for 2d year = £1000 + 50 = £1050;
∴ interest „ $= £1050 \times \frac{5}{100} = £52,\ 10s.$
Principal for 3d year = £1050 + £52, 10s.
= £1102, 10s.;
∴ interest „ $= £1102,\ 10s. \times \frac{5}{100}$
= £55, 2s. 6d.;
∴ amount at end of 3d year = £1102, 10s. + £55, 2s. 6d.
= £1157, 12s. 6d;
∴ compound interest on £1000 = £1157, 12s. 6d. — £1000
= £157, 12s. 6d.,
which exceeds the simple interest by £7, 12s. 6d. Ans.

FEMALES.

1. 53·4) ·011214 (·00021
1068
―――
534
534

Proof.

$$\frac{11214}{1000000} \div \frac{534}{10}$$
$$= \frac{11214}{1000000} \times \frac{10}{534}$$
$$= \frac{11214}{534} \times \frac{10}{1000000}$$
$$= 21 \times \frac{1}{100000}$$
$$= \frac{21}{100000} = ·00021.$$

2.
$2\frac{1}{3} = 2·333$ | 3 . . .
$72\frac{5}{8} = 72·625$ |
$316\frac{1}{6} = 316·166$ | 6 . . .
2·875 |
―――
394·000 Ans.

3. 60 — 13·95 = 46·05 number of miles walked first 3 days;
∴ $\frac{46·05}{3} = 15·35$ „ „ each day.

4. His share of the whole mine = ·1875

$$= \frac{1875}{10000} = \frac{375}{2000} = \frac{3}{16},$$

$$\text{and } ·1\dot{7} = \frac{16}{90} = \frac{8}{45};$$

$$\therefore \frac{8}{45} \text{ of } \frac{3}{16} = \frac{1}{30};$$

$$\text{and } \frac{3}{16} - \frac{1}{30} = \frac{90-16}{480} = \frac{74}{480} = \frac{37}{240} \text{ Ans.,}$$

the fraction of the whole mine which he has left.

Grammar.

1. (*a*) An adverbial *phrase* is an incomplete thought expressing the meaning of an adverb; as, *into the silent lake; upon the stroke; through the water; like a swan.*

An adverbial *sentence* is a complete thought expressing the meaning of an adverb; as, *as I rose upon the stroke; when a huge peak upreared its head.*

(*b*) *as*—a temporal conj. introducing a subordinate adv. sent.
heaving—incomplete part. qualifying *boat.*
like—adv. modifying *heaving*, and gov. dat. case *swan.*
swan—dat. case gov. by *like* (or obj. gov. by *to*).
behind—forming part. of prep. phrase *from behind*, gov. obj. *steep.*
till—prep. gov. *then* (=a noun).
then—(adv. =) noun, obj. gov. by *till.*
bound—abstr. noun, neut. sing. obj. in apposition with *steep.*
as if—conj. phrase, comparative, introducing subordinate sent.
instinct—adj. qual. *peak.*

(*c*) I was vigorously rowing through the calm waters of the lake, and as I pulled, my boat rose and fell with a swan-like motion. All at once I came in sight of a large dark rock, which seemed almost instinctively to come from behind the precipice, that had prevented me from seeing it.

2. *a* or *ab*, meaning *from*, is the prefix in *a*-vaunt, *ab*-dicate, and *a*-vert.
ad, meaning *to*, is the prefix in *ac*-quaint, *a*-chieve, *ad*-venture, *ac*-cuse.

Geography.

1. *See same question answered under Second Year in this number of Magazine.*

2. In journeying by land from the mountains of Abyssinia to Jerusalem, the most convenient route will be to follow the Tacazze, a tributary of the Nile. Beginning among the mountains, say at the site of Magdala, which was taken by the British under Napier in 1868, we follow the Tacazze till it changes into the Atbara, the third great tributary of the Nile, the most wonderful river in the world. Following the windings of the river through Nubia, we continue our journey along its limited valley, passing the towns of Berber, Dongola, Ipsambool, and Derr. Entering Egypt, we find that this country depends on the Nile for its fertility. We may visit on our way the interesting ruins of Thebes, and the towns of Kenneh, Siout Ghizeh, and Cairo. We may now turn east to the Suez Canal, crossing which we strike across the desert, following if we choose the route which the Israelites took in journeying from Egypt to the Holy Land, crossing into Palestine by the southern boundary, and arriving at Jerusalem, our destination, through the ancient tribe of Judah, visiting those places which have been identified with Engedi, Hebron, Bethlehem, etc.

3. RIVERS.

FLOWING INTO THE PACIFIC OCEAN.

River	*Rises in*	*Flows*	*Through*	*Falls into*
Meinam.	Borders of China.	S.	Siam.	Gulf of Siam.
Mekong.	„	S.	Annam.	Chinese Sea.
Yang-tse-Kiang.	Thibet.	E.	Central China.	Yellow Sea.
Hoangho.	„	E.	Northern „	„
Amoor, or Saghalien.	North of Mongolia.	E.	S.E. of Siberia, and north of Manchooria.	Gulf of Tartary.

FLOWING INTO ARCTIC OCEAN.

River	*Rises in*	*Flows*	*Through*	*Falls into*
Lena.	W. of Lake Baikal.	N.E. and N.	Eastern Siberia.	Arctic Ocean.
Yenisei.	Mongolia.	N.	Central „	Bay of Yenisei.
Obi.	Altai Mts.	N.W. and W.	Western „	Gulf of Obi.

History.

1. The explanation of the fact that Henry VIII. was more absolute than other English kings, lies in More's statement that

there never would be wanting some pretence for deciding in the king's favour, as that equity was on his side, or the strict letter of the law, or some forced interpretation of it; or, if none of these, that the royal prerogative ought with conscientious judges to outweigh all other considerations. It was believed at the time that the king could do no wrong, and that the king could do as he pleased with the persons and property of his subjects, and that a man had a right to no more than the king's goodness permitted. The vast concentration of all secular and ecclesiastical power in a single hand accustomed the people to the personal government which began in this reign.

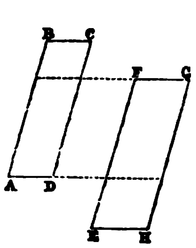
2. No sovereign could have jarred against the conception of an English ruler which had grown up under Elizabeth more utterly than James the First. His boasting, his want of personal dignity, his coarse buffoonery, his drunkenness, his pedantry, and his contemptible cowardice stood out grotesquely when contrasted with all that men recalled of his queenly predecessor.

3. The battle of Plassey was fought by Clive in 1757, when he defeated the Nabob of Bengal. This victory began the empire of India in the East. From that time the English became the actual rulers of Bengal, Bahar, and Orissa, though a new nabob was appointed, and they were formally given over by the Mogul Emperor in 1765. In 1760 the districts of Burdwan, Midnapore, and Chittagong were ceded to the English in payment for the services of the army. In 1766 Northern Circars was given up by the Nizam, and Guntoor was annexed in 1788. From that time the history of India is little else than a series of conquests and annexations, which have resulted in giving Britain actual possession of more than three-fourths of the whole country, and virtual power over the rest. The Mutiny of 1857-59 caused a thorough change in the relations of the country to Great Britain. The government was transferred from the East India Company to the Crown.

Euclid.

1. Prop. 30, Book I.

Rider.—Let ABCD, EFGH be two parallelograms which have their sides AB, BC, EF, FG respectively parallel to one another, viz. AB parallel to EF, and BC parallel to FG. Then DC shall be parallel to HG, and AD to EH. Because the opposite sides of parallelograms are parallel to one another, then DC is parallel to AB. But EF is parallel to AB; ∴ DC is parallel to EF. But HG is parallel to EF; ∴ DC is parallel to HG. In the same way it may be shown that EH is parallel to BC.—Q.E.D.



2. Prop. 48, Book I.

The converse of this proposition is, that in every right-angled triangle the square described on the side subtending the right angle is equal to the squares described on the sides containing the right angle.

Algebra.

1. $$\begin{aligned}1+x(x+1)(x+2)(x+3)&=1+(x^2+x)(x^2+5x+6)\\&=1+x^4+5x^3+6x^2+x^3+5x^2+6x\\&=x^4+9x^2+6x+1+6x^3+2x^3\\&=x^4+(3x+1)^2+2x^2(3x+1)\\&=\{x^2+(3x+1)\}^2\\&=(x^2+3x+1)^2.\end{aligned}$$

2. Let A and B denote the two expressions, and D their greatest common measure, so that $A=mD$, and $B=nD$. Then since m and n cannot have a common factor (otherwise D would not be the G. C. M. of A and B), hence their L. C. M. $=mn$;

$$\begin{aligned}\therefore \text{L. C. M. of } mD \text{ and } nD&=mnD\\&=\frac{mD\times nD}{D}\\&=\frac{A\times B}{D}.\end{aligned}$$

Hence this rule. Divide the product of the two expressions by their G. C. M.

L. C. M. of $(2x^3-7x-2)(2x^2-x-6)$

$$\begin{aligned}&=\frac{(2x^3-7x-2)(2x^2-x-6)}{\text{G. C. M. }(x-2)}=(2x^3-7x-2)(2x+3)\\&=4x^4+6x^3-14x^2-25x-6. \text{ Ans.}\end{aligned}$$

3. $\dfrac{x}{2}-\dfrac{5x+4}{2}=-\dfrac{9-4x}{3}.$

L. C. M. of denominators $=6$;

$$\begin{aligned}\therefore 3x-15x-12&=-18+8x,\\ \text{or } 3x-15x-8x&=12-18,\\ -20x&=-6,\\ x&=\tfrac{3}{10}. \text{ Ans.}\end{aligned}$$

2. $\dfrac{4+3x}{1+2x}-\dfrac{1}{2}=\dfrac{x+19}{x+12}$

L. C. M. $=(1+2x)(x+12)2$;

$$\begin{aligned}\therefore (4+3x)(x+12)2-(1+2x)(x+12)&=(x+19)(1+2x)2,\\ 8x+6x^2+96+72x-x-2x^2-12-24x&=2x+38+4x^2+76x,\\ 6x^2-2x^2-4x^2+8x+72x-x-24x-2x-76x&=38-96+12,\\ 80x-103x&=-46,\\ 23x&=46,\\ x&=2. \text{ Ans.}\end{aligned}$$

Music.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May* **1878; and Pupil Teachers at end of Fifth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. How much per cent. should I gain or lose in giving 10d. for a French franc, at the exchange of 25·57 francs for the £ sterling?

2. How much ore must one raise in order that, losing 42½ per cent. in roasting, and $\frac{1}{16}$ of the residue in smelting, there may result 506 tons of pure metal?

3. If the discount on £567 be £34, 14s. 3¾d., simple interest being reckoned at 4½ per cent., in how many days is the sum due?

4. What sum must I have invested in the 3 per cents. standing at 90⅝, if a transfer of ⅔ of my capital to the 4 per cents. at 115 would increase my income by £7?

5. What would it cost to convey 144 miles at the rate of 5s. 0d. per ton per mile (insurance being demanded at ½ per cent.), a box weighing itself 3½ lbs., and containing 1050 rings, each weighing 1 dwt. 4 grs., and each being worth £1, 2s. 0d.?

FEMALES.

1. In what time will £225 amount to £256, 10s. at 3½ per cent. simple interest?

2. If 1500 copies of a book of 11 sheets require 66 reams of paper, how much paper will be required for 5000 copies of a book of 25 sheets, of the same size as the former?

3. The annual poor's rates on a net rental of £365, 7s. 3d. amount to £36, 8s. 9d.; what should be the net rental of an estate for which the poor's rates amount to £24, 5s. 10d. per annum?

4. A person buys shares in a railway when they are at £19¼, £15 having been paid, and sells them at £32, 9s. when £25 has been paid; how much per cent. does he gain?

Grammar.

'Yet,' *quoth* our Hostë, '*let* me *talke* to thee,
Why art thou so discoloured of thy face?'
Quoth he (the *Alchemist's*[1] servant),

[1] In the Middle Ages much cost and pains were bestowed on trying to find out how to make gold by a chemical process; this was called Alchemy.

'I am so used the hotë fire to blow,
That it hath changèd my colour, I trow.
We labour ever, and *poren* in the fire,
And, for all that, we fail of our desire;
For that *sciënce* is *us* so far *beforn*,
That we may not, although we had it sworn,
It overtake, it slides away so fast;
It will us *makë* beggars at the last.'—CHAUCER.

(*a*) Write out the sense of the above in modern English.
(*b*) '*The hotë fire*,'—what concord, now disused, do these words illustrate?
(*c*) What change do you perceive to have taken place in the pronunciation of the words *science* and *colour?* Is there any rule for this alteration of accent, and can you give other examples of it?
(*d*) Analyse the last four lines.
(*e*) Parse and explain the words in italics.

Geography.

1. Give 'Notes of a Lesson' on 'the United States,' under these heads:—
   (*a*) Boundaries and extent.
   (*b*) Mountains.
   (*c*) Rivers.
   (*d*) History.
   (*e*) Constitution.
   (*f*) Trade, manufactures, and great towns.

Illustrate by a map.

2. Compare the shape, size, and general character of the Atlantic and Pacific Oceans.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. What explanation would you suggest of the fact that England has not had a second sovereign named either Stephen or John?
2. How did we acquire the Cape of Good Hope? Trace the progress of British dominion in South Africa.
3. When was publication of debates in the House of Commons first tolerated? What part was taken by the City of London in obtaining that toleration?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Burgundy*.
Write, in small hand, as a specimen of copy-setting, '*Yet here Prince Edward stands, King Henry's son.*'

Composition.

Write a short essay on *Light and its Uses.*

Euclid.

(The only abbreviation admitted for '*the square on AB*' is '*sq. on AB*,' and for '*the rectangle contained by AB and CD*,' '*rect. AB, CD.*')

1. Draw a straight line from a given point in a side of a parallelogram which shall bisect the parallelogram.
2. If there be two straight lines, one of which is divided into any number of parts; the rectangle contained by the two straight lines, is equal to the rectangles contained by the undivided line, and the several parts of the divided line.

What is the corresponding formula in Algebra?

3. If a straight line be divided into two equal, and also into two unequal parts; the squares on the two unequal parts are together double of the square on half the line, and of the square on the line between the points of section.

Algebra.

1. Simplify $\left(x+2+\frac{4}{x-3}\right)\left(x-2-\frac{4}{x+1}\right)$.
2. Solve the equations:—

$$\text{(1.)}\quad \begin{cases} 13x-12y=133, \\ 30x-29y=167. \end{cases}$$

$$\text{(2.)}\quad \frac{39(1-x)}{4}=\frac{50x}{x+1}+3x.$$

3. A man was employed on the condition that for every day he worked he should receive 3s. 6d., but for every day he played he should forfeit 2s. 6d.; at the end of 40 days he received £4. How many days did he work?

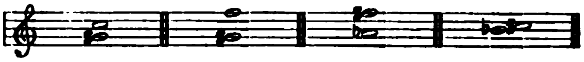
Mensuration.

1. The sum of the sides of an isosceles triangle is 306 feet, and each of the equal sides is five-eighths of the third side; find its area.
2. The sides of a right-angled triangle are 27 and 43 feet; find the area of the circle described on the hypotenuse as diameter.

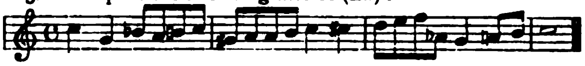
Music.

A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of B (*Si*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.
2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms:—



3. Transpose the following into A (*La*):—



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. 25·57 frs. at 10d. each = 255·7d.
£1 sterling = 240

∴ he loses 15·7d. on 255·7.

255·7d. : 100d. :: 15·7d. : loss p. c.

255·7) 1570·0 ($6\frac{358}{2557}$. Ans.
15342
―――
358

2557

2. A loss of 42·5 p. c. = 57·5 left before smelting.
A loss of $\frac{8}{19}$ of 57·5 = $\frac{11}{19}$ of 57·5 pure metal out of 100 tons.
If $\frac{11}{19}$ of 57·5 tons be pure out of 100 tons, how many tons are required to have 506 pure?

$\frac{11}{19}$ of 57·5 : 506 :: 100 tons.

$$\frac{100\times 506\times 19}{632\cdot 5}=\frac{961400}{632\cdot 5}\text{ tons.}$$

6325) 9614000 (1520 tons. Ans.
6325
―――
32890
31625
―――
12650
12650

3. Present value of £567 = £532, 5s. $8\frac{4}{7}$d., the discount being £34, 14s. $3\frac{3}{7}$d.
Present value of £104½ = £100, the discount being £4, 10s.
For convenience in reducing, the terms may be thus arranged:—

£	s.	d.		£	s.	d.		
532	5	$8\frac{4}{7}$	:	34	14	$3\frac{3}{7}$	:	365 days.
20				20				
10645				694				
12				12				
127748				8331				
7				7				
894240				58320				

90s. : 2000s.

$$\frac{365\text{ days}\times 2000\times \cancel{58320}^{648}}{\cancel{90}\times 894240}=\frac{365\times 100\times 648}{44712}=\frac{36500}{69}=$$

69) 36500 ($528\frac{68}{69}$ days. Ans. 529 nearly.
345
―――
200
138
―――
620
552
―――
68
69

[*Continued on page* 151.

The Practical Teacher.

A MONTHLY EDUCATION JOURNAL.

To Subscribers.—The *Practical Teacher* is published on the 25th of every month. Price 6d.; post free, 7½d.; sent post free for a year, 7s. 6d.

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Subscribers not receiving their copies regularly are respectfully requested to write to the Publisher.

To Correspondents.—All literary communications should be addressed, THE EDITOR OF THE PRACTICAL TEACHER, Pilgrim Street, Ludgate Hill, London, E.C.

Accepted contributions are paid for within twenty-one days of publication.

The Editor cannot return rejected MSS.; authors should therefore retain copies.

Publications Reviewed.

NOTICE.

We have received two childish complaints from authors whose works have been unfavourably noticed in these columns. The Editor cannot under any circumstances whatever enter into a correspondence respecting reviews which appear in the P. T. All communications on the subject will be put into the waste-paper basket. Our reviews are done by well-known able men and women above suspicion, and we can assure our readers that the publications submitted to us will be **fairly, candidly,** *and* **fearlessly** *dealt with, no matter whose imprint they bear.*

Lays of Romance and Chivalry. By W. Stewart Ross. Cr. 8vo, 70 pp. Price 2s. London: Stewart & Co.

These twenty ballads are very spirited, and well bear out their title as both chivalrous and romantic. They remind one of divers poets who have heretofore achieved good fame in similar fields of song, as Macaulay and Aytoun, and the authors of the *Norse Sagas* and the *Neibelingen-leid;* with not unfrequently details of the picturesque-antique worthy of Chaucer, and some touches like *Chevy Chase* and the *Percy Relics*. However, they are not mere echoes, far less imitations,—as our extract shall prove,—but have considerable merit and originality: albeit there is rather too much of blood and thunder pervading the booklet, and many a line defective as to rhythm, while the rhymes are too generally only alternate. As the author will doubtless be heard of again (and indeed these 70 pages are probably only an instalment of a whole goodly volume to come), it may be not amiss to suggest a few corrigenda for another edition, before we offer him the larger meed of commendation where we judge it well deserved. It is fair then to ask if the author can be right in making 'the Graeme' contemporaneous with Agricola and the Druids: surely it is an anachronism to call 'the gallant Graeme the Druid's joy;' at all events prehistoric lore is needful to be sure of such a combination of ideas. In the same ballad, a vigorous one as the rest are, several such faults in ear music may be indicated as these lines prove: 'And far, far, was her father famed,' where the alliteration is terrible, and the far and father almost ludicrous; 'And sprang agile the hunted deer,' which of course should be, 'And agile sprang;' 'He's down, O gods! he's up once more,' where the two elided verbs are too familiar for the situation; and such a careless error as 'Cromlechs rocking in the wind,' easily amended into 'logans.' But throughout, a little care wisely given would improve some scores of lines, if the author will diligently apply the *limæ labor.*

And now let us vindicate our judgment of what is on the whole an honest conviction, that the booklet is one of good performance, and of better promise, by extracting in full a splendid Norse specimen, worthy of any pen, headed 'The Raid of the Vikingr.'

The Raven, the Raven is dark on the gale
That wrathfully roars through the cordage and sail;
At the black dragon-prow the ocean is dashing,
On the storm-battered deck shields and cymbals are clashing;
And 'Hurrah and Hurrah!' shout the sons of the main,
And swells the broad chest of the steel-shirted Dane;
And the roar of the chant drowns the roar of the sea—
'War-hammer, war-axe, and red Odin for me!'

Their axes are swinging, their brass shields are ringing;
They quaff horns of mead, and they stretch to the oar,
While their sagas keep time in terrible chime
To the whirls of the ocean that boil evermore;
And Hilda the dear one, and Brenda the fair,
Named in sagas of love or of terrible glee,
Mix again and again with the awful refrain,
'The ocean, my galley, and Odin for me!'

A heap of red cinders, bespattered with blood,
Marks where the Thane's castle rose sternly at morn,
And dashed is the rood from the height where it stood,
On the loftiest tower of the Abbey of Thorn.
On Gurth's ruined grange the barn is on fire,
The barley's ablaze on the upland and lea;
Louder, louder the song peals wrathful and strong,—
'No white Christ, but Odin, red Odin for me!'

And the Raven and Horse are met in the dell,
With spiked club and axe-swing, with groan and with yell.
The wolf and the crow—they wait for the dead,
Where the flowers of the mead bloom in one horrid red;
And the lays of the scalds peal awful and high,
And the valkyry ring of the Norse battle-cry,
'Niflheim, frigid hell for the Dane that will flee!—
No Christ but the Nordland's red Odin for me!'

Ah! redder now flushes the wild rose's bud,
And the eye of the daisy is blinded in blood.
Now England, prepare for raid, rapine, and lust,
For your gallant White Horse lies low in the dust!
Victorious the jarl sings of Balder and Thor,
And the souls of the brave that return never more:
'Ho, yell of the battle and roar of the sea,—
War-hammer, war-axe, and red Odin for me!'

Another very spirited ballad is 'Richard Lion-heart;' also the 'Pale Bride Death:' but as our space is exhausted, we must refer the reader to the publishers at Holborn Viaduct if he wishes to gratify his curiosity further.

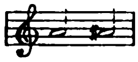
The Rudiments of the Theory of Music. Price 1s. 3d. By H. A. Bamford. Manchester and London: John Heywood.

We have much to commend and little to censure in this clearly-written little introduction to the elements of music, which, being 'designed for the use of Pupil Teachers and Students in Training Colleges,' will do good service. We object to the mania for new names, from which Mr. Bamford has not altogether escaped, and to the chapter (viii.) headed Diatonic Intervals (but which also deals with chromatic intervals), as more properly belonging to harmony, which the author professes to omit. In this latter we find the perfect fifth termed 'the larger diatonic fifth;' and this, when increased by a semitone, is termed a *chromatic fifth.* Why not call it an augmented fifth, by which name it is already known? We fully agree with Mr. Bamford's objection to the ill-advised term pluperfect as applied to tritone fourth (F to B), a term founded on the mistaken idea of imperfect meaning *less.* A fiddle-string tuned too sharp is painfully *imperfect* instead of being *more than perfect.* The perfect fourth is so called on account of its being perfectly satisfactory to the ear, when comprising five semitones (G to C); whereas, if subject to the change of a semitone *in either direction*, the consonance becomes a dissonance (G to C♯, or G♯ to C), to name which more than perfect is to ignore the meaning of the word *perfect.*

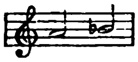
Mr. Bamford shrinks from the term *common*, the well-established name for time with alternately accented and unaccented beats, and prefers the word *duple.* This latter may be, in itself, unobjectionable, and somewhat self-explanatory, but for every new term a strong reason, indeed almost necessity, should be shown. Duple is by no means so general in application as many seem to suppose. In defining common time, usually marked 𝄴, or for quicker modes 𝄵 (which latter Mr. Bamford associates with *alla breve* time), the term *quadruple* is used for four crotchets in a bar. But a crotchet is no more a unit or standard than is the minim or any other note. A passage in $\frac{2}{4}$ time taken very slowly—lento or adagio—necessitates the beating or counting of every quaver, and thus throws four beats into each bar. This term beat, again, which Mr. Bamford seems to regard as something fixed or definite, is purely relative, subject to the guidance of the *rate of movement*, and can be no more definitely measured than can the degree of a circle.

Mr. Bamford has also a curious way of explaining *accent.* He says: 'If the numbers *one, two—one, two*—be repeated over and over again at regular intervals, it will be found that one of the words will, instinctively, be given with greater *stress* than the other.' This 'instinctive' difference is certainly a novel explanation of accent. We rather prefer the old-fashioned syllabic stress—easily illustrated by suitable words—to this imaginary instinctive change by repetition. Mr. Bamford is also incorrect in saying that the secondary or weaker accent falls upon the third beat of triple as upon quadruple time. In triple time the strong accent falls, of course, upon the *first* beat, the weaker accent upon the *second*, and not upon the *third* beat, which latter is unaccented.

In saying that 'a minor second is often called a diatonic semitone,' we have a confusion of terms. A minor second may be a chromatic as well as a diatonic semitone; in fact, the term minor second simply means a note one semitone from another. The semitone is termed chromatic when the note retaining its name is raised or depressed a semitone by an accidental. The same change, when effected by altering the name of the note, bears the term diatonic. Thus,

A to A♯  is chromatic;

whereas the same change,

A to B♭  is diatonic.

Mr. Bamford is as evidently partial to the term *transcription* as was the old lady to *Mesopotamia.* 'The process of copying a piece of music in a different time is called *transcription*,' p. 56. At p. 64 we are told that the term *transcription* is applied to rewriting music at the same pitch in a different stave. Also, 'we may transcribe from one key to another when we alter the pitch, or from one clef to another when we do not alter the pitch.' Beginners will be puzzled by all this, and stand aghast at the term *transcription*, whereas they would have no difficulty in understanding the direction, 'Write the example given (in the Treble) in the Tenor clef;' or, 'Write the time given (in $\frac{3}{4}$ time) in a quicker mode of triple time without altering the nature of the time.' The use of vague technical terms in music is by no means advisable.

There are more points which we are compelled, for want of space, to omit. But there are more excellences than defects in Mr. Bamford's book, which, for lucid and methodical arrangement, is entitled to high praise. The addition of an index would add to the utility of this well-arranged introduction to musical theory, and be of considerable help to the young students for whom it is intended. Mr. Bamford's diagram, very similar to Mr. Curwen's 'Modulator,' is most useful to explain changes of key, and may doubtless be occasionally used with advantage in giving oral vocal exercises. The explanations also, judiciously given in smaller type, show that Mr. Bamford really understands what he is writing about. The book is admirably printed.

Lessons in Elementary Mechanics. Designed for the Use of Schools and of Candidates for the London Matriculation and other Examinations. By Philip Magnus, B.A., B.Sc. Seventh edition, 330 pp. fcap. 8vo. 3s. 6d. London: Longmans, Green, & Co.

Although it is scarcely six years since this book first saw the light, we now have before us the seventh edition, revised and enlarged. Mr. Magnus' method is novel, having been primarily suggested by the requirements of the Elementary Examinations in Natural Philosophy at the London University. Without a mention of Trigonometry, he is able to convey a very good groundwork of knowledge on all points, except a few from which he is precluded by the incapacity of his tools. And, in truth, this is almost the only objection that a conscientious reviewer can possibly find to this work. In our opinion, a very little Trigonometry, easily compressible into a page, would not only render the results neater, but would shorten the method by which they are obtained, and

lessen the difficulty of fixing them in the memory. We refer particularly to the resolution of forces along a plane or system of planes, and the analytical conditions of Equilibrium. But, we repeat, this is the only fault, and probably even upon it the author holds an opinion directly contrary to our own, in which he is to some extent justified by the limitations imposed by the London University.

In this edition the novelties are 'A few Notes on the Centimetre-gram-second System of Units of Measurement, and also some additional Examples on the Change of Units.' Besides this, 'the solutions of the problems given at the Matriculation Examination are continued up to date.' But this short statement, taken from the Preface, by no means includes all the improvements which have been made since the first edition in 1875. Then there was only *one* Matriculation paper given, now there are *thirteen*, besides, of course, all the numerous questions scattered here and there in different parts. Then there was, we believe, not the slightest reference to the principle of Virtual Velocities, or, as we must now call it, Virtual Work; but in the present copy we find a clear statement of this very important law, as well as a few additional, and highly necessary, notes on the Theory of Energy. Thus much for the subject-matter. Not less improved are the answers. Solutions to the additional papers are given, and all the old mistakes corrected. We have in our possession a copy of the first edition, in which are numerous corrections. Taking this, we compared it with the present, and found that we were now agreed, even when the only ground for our quarrel was the last figure of a decimal, or a small error in a fraction.

The book has been so long before the public that it is almost superfluous to speak of its arrangement. We have first Kinematics and then Statics. Personally, we believe, with Professor Minchin, that the reverse and more rational order is the simpler. But this is an altogether subordinate matter.

The chief result of the 'cram system' is, that mathematical works intended for that object, consist of dry bookwork and a number of examples which can be solved 'by the methods of the above,' if only the student is born under a sufficiently happy star. Unfortunately this is not the case with most students, and they therefore, before long, stow their Algebra away in the darkest corner of the dustiest cupboard they can find, hoping never to be forced to reproduce any portion of them. Our author's method entirely obviates this. In common with a now rapidly increasing minority, he incorporates a large number of typical examples into the text, pointing out where special difficulty is likely to occur. Helped thus, no one of ordinary intelligence should find any difficulty in working right through all the examples which appear at the end of each chapter. If he is ingenious enough to get puzzled, he will probably be helped by the little hints which are scattered up and down in the answers.

But our admiration for the book has already betrayed us into double as much as we at first intended, and so we will finally recommend it as the *standard* work for London Examinations, adding, what to our mind is a greater compliment than anything we have previously said, that not even on the minutest and most catching points need the student fear that Mr. Magnus will lead him astray.

Text-Book of Practical Organic Chemistry for Elementary Students. By H. Chapman Jones, F.C.I., F.C.S., etc. 100 pp., with Index. Price 2s. 6d. London: Joseph Hughes. 1881.

Mr. Chapman Jones has produced a very creditable manual, which must prove invaluable to the class of students for whom it is specially designed. So far as our acquaintance with the literature of this subject goes, the book before us is absolutely the first of its sort in the field. Got up neatly and in small compass, it is a very good introduction to a now-a-days alarmingly wide and daily widening subject. It is meant to assist young students in their laboratory work, and accordingly is of convenient pocket size, and contains detailed instructions as to how to set to work on an experiment. The apparatus employed is always inexpensive, and thus we are spared the mortification often experienced, when using an ordinary text-book, of finding ourselves unable to verify the results, and having to fall back on faith in the word of our author.

The following are the divisions of the book:—Cyanogen, Carbonyl, Paraffins and Haloid Substitution Derivatives, Olefines, Acetylene, Aromatic Series, Alcohols, Ethers, Aldehydes, Acids and Ethereal Salts, and Organic Analysis. It will thus be seen that Professor Jones has managed to include a portion of almost every division of the chemistry of the Carbon Compounds. At the same time, we almost think that the selection of subjects to be treated is made by the guide of simplicity of composition rather than commonness of occurrence. If this be the case, the result must be to lessen the interest in the manual; if not, short notes on the Tannins, Anilines, Glycerines, and Alkaloids would, in our opinion, add greatly to the value of the book. Starch and Cellulose, too, deserve more than a passing mention. Organic Analysis is scarcely so well treated as the high standard attained by the rest of the book would lead us to expect. Considerably more tabulation is desirable before it can be called perfect.

But we are fully aware that it is an easy thing to find fault, and consequently are happy to conclude with a word of unqualified praise, and say that no such manual so unpretentious has, in our opinion, attained so high a standard. Professor Jones has done his work well, and we are glad to congratulate him on its successful termination.

Types of Nations. A Series of Six Plates. Price 2s. each; or, mounted on rollers, varnished, 4s. each. London: W. & A. K. Johnston.

These beautifully-coloured artistic-looking studies of national life do credit to the well-known house responsible for their issue. The limner has cleverly hit off the peculiarities of each race, and produced a series of pictures which irresistibly 'catch the eye.' They are fit to adorn the walls of any schoolroom. Their use would invest the Reading, Geographical, and Object Lessons with new life.

Imperial Map of Asia. Size, 72 in. by 63 in. Price on rollers, varnished, 21s.

This excellent map is deservedly styled 'Imperial.' Teachers who want a new large map of Asia may with confidence buy it.

Notes of Lessons for Infant Classes and the First Standard. By J. E. Singleton. Crown 8vo, 142 pp. Price 2s. 6d. London: Jarrold & Sons.

This useful volume is so clearly arranged and thoroughly practical, that we are greatly mistaken if it has been 'done to order.' We are inclined to the opinion that Mr. Singleton used it in MS. form long before it was given to the world.

There are eighty-two lessons, forty-three of which are on 'objects;' seventeen on 'subjects;' and the complement on 'animals.' Though professedly written for Infants and Standard I., the lessons—at least a fair proportion of them—may be given with advantage to the children in the higher standards. Capital outline sketches, such as a teacher ought to enliven his lessons with, illustrate the text.

The book—though, of course, the wise teacher will not *confine* himself to it for examples, etc.—deserves a wide circulation. It will save the weary teacher many an hour in hunting up his oral lessons. The binding is neat and durable.

English Spelling and Dictation. In Four Parts. By D. Campbell. Parts I. and II., *each* 4d.; III. and IV. in one vol., 4d. London: Thomas Laurie.

Mr. Campbell's 'Spelling and Dictation' manuals are suitable for use in all grades of schools. Part II. is admirably adapted to the three highest standards. The third volume, comprising Parts III. and IV., will be found very useful to pupil teachers in the earlier years of their apprenticeship. Teachers contemplating a change of spelling-books should examine these carefully-prepared exercises.

The Geography of the Oceans. By J. F. Williams, F.R.G.S. London: Philip & Son.

This attempt to place the main facts relative to the 'great world of waters' is successful in every way. The book—comprising nearly 250 pages—is not only valuable for the extent and accuracy of its information, but pleasant reading withal. The researches of Captain Maury, together with the more recent results of the *Challenger* Expedition, are here judiciously blended with the conclusions of modern geographers. Matters that require some detail of reasoning processes are thus treated, and while no statement is left in doubt, there is an absence of excessive explanation, together with the *writing down* to students that disfigures many books for educational purposes. With this manual in hand the young teacher may 'sail away' most pleasantly over the ocean, and with a common map before him make his class acquainted with the waters of the world. The information brings us down to the successful issue of the *Vega*, which in 1879 brought honour to Sweden in accomplishing the *North-East Passage* that Sir H. Willoughby first attempted in 1553. 'Many other expeditions,' says Mr. Williams, 'from different countries have started on the same errand, always without success, and often with the loss of ships and many brave sailors. After the lapse of 326 years, and after the most experienced seafaring men had declared the undertaking to be an impossibility, the *North-East Passage* has at last been accomplished without the loss of a single life, without a case of sickness amongst those who shared in the enterprise, and without the slightest damage to the vessel. It has been also effected under circumstances which prove that the feat can be repeated in most years, perhaps every year, and within the space of a few weeks.' This we quote as an example of the pleasant reading and thoughtful writing that characterize these pages. In speaking of the perfect repose that is supposed to prevail at the bottom of deep seas, Mr. Williams adduces in proof the perfect state of the delicate shells of the *foraminifera*, which, he urges, in case of there being anything like a strong submarine current, 'would have been ground to powder.' So they are, it may be replied; and a quantity of this so-called fine powder no larger than a pin's head, if placed under microscopic power, displays myriads of these tiny shells. Specimens of these wondrously minute objects were found in all parts of the sand obtained from the borings of a Government well at Sheerness, and displayed marvellous elaborate beauty in all the specimens examined. The fact is, that these objects are too minute to be destroyed by the action of water currents on earthy or rocky materials. Mr. Williams seems to favour the word *salinity* in several instances, in preference to the plainer and perfectly accurate word *saltness*. With this exception there is a remarkable freedom from difficult terms on the one hand, as also from any attempt at excessive plainness of style on the other. Speaking of the changes effected by the erosive action of the sea on the English coast, Mr. Williams instances the cliffs of Sheppey, where, 'at a spot where the cliffs are from 60 to 80 feet high, fifty acres have been lost in twenty years.' This statement, resting on the good authority of Sir Charles Lyell, is correct enough as far as it goes, but conveys the impression of this loss of land being a remarkably extensive instance. Now the Sheppey cliffs rise abruptly from a spot known as *Scrop's Gate*—due south of the Nore Light vessel—to a general height of upwards of 200 feet, and thus continue for 4 miles to the Warden Point, where they descend as abruptly to the beach of Leysdown and Shellness. Instead of 50 acres, the loss in twenty years may be more correctly stated in hundreds of acres. As a striking example of the extent of this change, we may mention that the church of Warden village was built—with the stones taken in 1830 from Old London Bridge—so well inland, it was thought, as to be for ever safe from danger by the sea. Yet this church 'went to sea,' as the local phrase had it, together with the Government Preventive Station and field after field, some ten or a dozen years ago! The accumulation of shingle and sand is equally remarkable on many parts of the coasts, as at Dungeness, Hythe, Rye, and Winchelsea. Almost while we write this, the inhabitants of Sheerness are imploring Government aid to improve and make good the sea-walls to protect the town from such devastating effects as were produced by recent high tides.

Mr. Williams' book contains a goodly number of maps and diagrams. A few well-executed woodcuts would greatly add to the value of these pages. The wood-engraving at page 58, together with the diagram (page 81) on the Tides, are the only ones we have noticed, and both are unworthy of the book. We would also suggest an enlargement of the index, or rather a supplementary one with names somewhat in

detail, in addition to the very useful, yet too brief, one of two pages devoted to the principal subjects treated of.

The co-tidal chart is clear and distinct. The sectional diagram giving approximate land elevations and sea depressions, represents mountain heights jutting upwards as sharp and regular as church spires. The chart on ocean currents, too, might be improved by being printed like the maps in colours. These, however, are comparatively small matters and trifling defects—if such they may be called. Altogether the work is thoroughly well done, and cannot fail to be highly useful to readers of all kinds as well as to geographical students. The trade and commerce details are wisely given in a tabular summary. We strongly recommend the book.

A Series of Practical Standard Copy-books. By Joseph Cox. In 15 parts, price 2d. each. London: Joseph Hughes.

We have just had submitted to our notice the above series of copy-books. It has fallen to our lot in past years to examine almost every kind of book intended and designed to teach children to write well, and without doubt many of them are well adapted to accomplish their purpose. But we have never seen a series of copy-books at all equal to those published by Mr. Hughes.

In whatever light we view them,—in their 'get up,' the style in which they are printed, their graduation and consequent adaptation to children in all the Standards from the First to the Sixth,—the help they give to the youngest scholar, as well as the occasional assistance they present to the more advanced pupil, are all alike most praiseworthy. In our judgment, these copy-books stand unrivalled, and all destined to hold and maintain a very high position in our elementary day-schools. Each page is headed with very clear and important instruction to the child, and which cannot fail to facilitate its improvement, while it must likewise save both the time and labour of the master. The subject-matter, too, of these books, and the wise method in which that matter has been arranged, are of such a character as must ensure the interest and attention of the scholar. While he is learning to write, if he use this series of copy-books, he will, at the same time, be making himself acquainted with the elements of grammar, geography, arithmetic, and geological science. We have long held the opinion that the faculty of writing is a *gift* which, while all may possess it, all do not possess it in the same degree; but we feel confident of this, that to whatever extent the talent may have been conferred, they who use these books will have the faculty *educated* in the truest sense of the term. We have therefore the greatest pleasure in commending Mr. Hughes' series of writing books to the attention of all masters of elementary schools.

A Manual of Music. By J. L. Watson. Hull: Brown & Son; London: Simpkin & Marshall.

This manual forms one of 'Browns' School Series,' which includes several useful school-books. Mr. Watson's pages are devoted to explanations of the elements of music, in order to enable pupil teachers and students to pass examinations in musical theory. For this, Mr. Watson's book, if not a full guide, is a safe one, and free from fanciful theories. Some writers on the elements of musical science are continually thrusting forward new notions and attempts to remodel the well-understood nomenclature. Mr. Watson, while avoiding this, explains clearly the principal matters connected with the rudiments of the science. Several of the definitions are terse and happy.

Almost the only thing to be regretted is, that the explanations are generally brief—a necessity imposed by having to treat of so many matters of musical science in the limit of one hundred rather largely printed pages. In the chapter on Time, some omissions may be judiciously made, descriptive of varieties of signatures which are not used, as, for instance, $\frac{2}{8}$ time, *i.e.* two quavers in a bar, which nobody is ever likely to meet with. Again, in giving the two-semibreve time, in which some old ecclesiastical music is written, Mr. Watson rightly enough explains this to be *Four-two* time, on the principle of regarding the semibreve as the standard of time measurement. But this species of time is usually indicated by the terms *Alla Breve*, which students should be helped to answer. We would also prefer the sign $\frac{2}{4}$ to $\frac{4}{8}$. In explaining the Italian words commonly used to indicate the rate of time movement, Mr. Watson adheres too closely to the literal meaning of some terms which have outgrown their original signification. *Andante*, for instance, is now understood to incline to slow and gently-moving time, rather than to be synonymous with *Moderato*, as Mr. Watson would lead us to conclude. Again, *Adagio* is understood to be decidedly slow, rather than merely 'deliberately.' These, however, are very minor imperfections. A student who can answer correctly the excellent series of questions and exercises at the end of Mr. Watson's chapters will have attained no contemptible knowledge of musical elements, and be able to pass an ordinary examination thereon without fear of failure.

The 'get up' of the book is all that could be desired, Messrs. Brown & Son having done their part of the work remarkably well.

The Elementary School Manager. By H. R. Rice-Wiggan and A. P. Graves. Pp. 282, crown 8vo. Third edition. Price 5s. London: Isbister.

It has often been urged as an objection to our young Inspectors, that they were not familiar with the daily routine of school life. That objection cannot certainly be urged, with any show of reason, against the writers of this useful volume. Few teachers would have credited them with so complete and practical a knowledge of the inner working of an elementary school as this book reveals. There is evidence on every page that the work has been done *con amore*. No school manager desirous of discharging his duties aright should be without a copy. To the *correspondent* of the school, it is indispensable. Its use will save him no end of trouble. He has here at his fingers' ends a copy of every useful form, from the Conscience Clause Regulations of the Elementary Education Act, 1870, down to the recently issued circular to H.M. Inspectors with regard to the teaching of class subjects.

But the manual is not simply a collection of dry schedules. In the preface we are told that the authors have endeavoured 'to help managers to detect, to trace to their causes, and to remedy all

those flaws in their school which, in spite of precautions, are constantly recurring.' That promise has been abundantly fulfilled. With the spirit of the work we are more than pleased. One feels as they read the following hint (the first of four given to managers in dealing with the troubles and difficulties of the teacher), that the Inspectors who penned it are men of the right stamp: 'He may be depressed by the prospect of the coming examination. If you know him to have done his utmost for the school, a few kindly words may inspire him with new heart for his work.'

The book abounds with valuable suggestive hints to the teacher. Our only regret as we closed it was, that the new Code in its entirety had not been inserted.

'The Elementary School Manager' is worthy a place in every schoolmaster's desk, and on every school-manager's bookshelf.

Walker's Slate-Paper Projection Atlas. Price 1s.
Walker's Slate-Paper Outline Atlas. Price 1s.
London: Walker & Co.

The old pedagogue who taught geography from text-books framed after the fashion of *Mangnall's Questions*, is, we trust, fast dying out. It is now generally acknowledged that this interesting study cannot be successfully pursued without constant practice in mapping. The objection to the neat outline maps hitherto issued by several well-known firms has been that their use entailed too great an expense. These ten slate-paper maps surmount that difficulty. They are printed in white on a black ground, which serves all the purposes of an ordinary slate. They would have been all the more valuable if about one-third of the rivers had been omitted and the positions of the great watersheds indicated. They will prove a boon to every teacher and student of geography.

The Multum in Parvo French Verb Book. Containing all Regular and Irregular Verbs, conjugated in *two* pages, etc. By L. Nottette, B.A. (Paris). London: Simpkin, Marshall, & Co. Paper, price 6d.

He who contrives to keep his temper after investing his sixpence in this book is indeed a praiseworthy model of patience and long-suffering. It contains thirty-six pages, of which sixteen are devoted to panegyrics on M. Nottette's prolific book-making genius; in other words, advertisements of books which, though possibly everything desirable in their own way, have yet not the remotest interest to us in the present connection. Of the remaining twenty, three are taken up with title-page, preface, and index, while two more form a mere table to assist the student in referring to another book on the same subject. Thus winnowed down to half its not previously *Brobdingnagian* dimensions, no one can for an instant pretend that to learn this *multum in parvo* is at all an impossible task.

While to some degree admiring the ingenuity, we cannot but deprecate the pertinacity with which our author has interwoven his books one with the other. The preface introduces us to his *French Copy-Books*, a few pages further on we are referred to *French Language Simplified*, while to complete this process a portion of the book is utterly valueless except we purchase a third of M. Nottette's performances.

To turn now to the subject-matter itself. We have not succeeded in detecting any mistakes except here and there a chance *t* or *s* gone wrong, but in no case leading to anything serious. The title, however, raises expectations scarcely gratified on closer inspection. We are led to believe that we are to meet with every mortal verb in the moderate compass of two pages. We begin to think our former difficulties must now vanish under such able tutelage. We find the two pages in question. Eyeglasses and spectacles must come into requisition immediately. It is quite true that we have it all in two pages, but it can be easily imagined that when the primary tenses and meanings, and the singulars of the present indicatives of sixty irregular verbs, the manner of conjugation of all four classes, and multitudinous notes and addenda, are compressed into two pages, it is only done by using diamond type, and producing a result which is utterly ruinous to our eyesight, thus failing through its very success.

Besides verbs, we are treated to new ideas on French and English pronunciation, and various tables of weights and measures, which seem quite irrelevant until we remember that M. Nottette has probably failed to find a suitable place in any of his other works in which he might safely insert them. The tables, indeed, are a model of French fickleness. We are told that a decigramme is 1·5432 grains, but a gramme is given us as $15\frac{1}{2}$ grains; and while we gather that a mile (given as 1700 yards!) is 1609·314 metres, we get no nearer to the value of a metre than '3 ft. 3 in. and $\frac{3}{8}$.' This being the case with weights and measures, we are quite prepared to be told that while 1 franc = 9s. $\frac{8}{10}$d., 2 francs = 1s. $7\frac{1}{5}$d. We might multiply instances, but even the author will not accuse us of doing him injustice by taking too few examples. Consistency, not to speak of exactness, seems to be quite the last thing at which our author aims.

We have never had the privilege of visiting any part of England where *en* in *length* has the sound of any one of the French words *prince, peintre, princesse*, or *vin*. And surely there is difference distinct enough between the English and the French *f* in *actif.* But it is useless to multiply instances. We might fill up as much space as does the book we are noticing by mere comment upon its errors, but to do this could only weary. We may therefore only express our conviction that to teach French pronunciation by rule and rote can but prove ruinous. Indeed, it is as a result of this merely that most Englishmen having learnt their French prove as intelligible in Paris as they would in China.

In conclusion, we are sorry that not even after considerable efforts in disentangling this confused maze have we reached anything like a sufficient excuse for the existence of this publication.

Self-Culture for All. In six parts, price 6d each. London: Ward & Lock.

In this age of keen competition, no fitter advice could be given than that which heads this splendid serial, 'Above all things study.' Messrs. Ward & Lock, anticipating the anxious enquiry, 'WHAT am I to study' of the perhaps poor but ambitious youth bent on making his way in the world, have made a practical reply in issuing 'Self-Culture for All.' The title is the best explanation of the character and scope of the work. To young students, many of whom have

to earn the money they spend on literature, it will be of untold value. Equipped with the information 'Self-Culture for All' contains, any persevering young man or woman ought to make 'success in life' a certainty.

Cayzer's 1000 Arithmetical Tests. Price 1s. 6d.
Cayzer's 1000 Algebraical Tests. Price 2s. 6d.
London: Griffith & Farran.

Mr. Cayzer's useful and carefully-graduated Arithmetical and Algebraical Tests are so well known, that we must content ourselves with little more than announcing new editions of them. Each manual contains excellent *test* work, and, used in conjunction with the ordinary text-books, cannot fail to prove valuable auxiliaries. Principals have in these books ample material for compiling model examination papers.

As 'Tests,' we award them high praise.

Glimpses of the Globe. Fcp. 8vo, 156 pp. Price 1s.
Glimpses of England. Fcp. 8vo, 156 pp. Price 1s.
Glimpses of the British Empire. Fcp. 8vo, 184 pp. Price 1s. 6d. By J. P. Blakiston, M.A. London: Griffith & Farran.

Mr. Blakiston's 'Glimpses' are already so well known that a full description of them is hardly necessary here. Suffice then that each book fully meets the requirements of the Education Department in Geography under Art. 19, C. 1. The language in the volume designed for the Second Standard is too difficult,—a fault for which the Department alone, and not the author, is responsible. Mr. Blakiston has adopted a lively, chatty, and interesting style, and given us a series of books which, apart from their special adaptability to the Code requirements, will be highly prized by all lovers of geographical teaching. A few really good woodcuts interspersed throughout the volumes would, in the eyes of the young folk who will use them, have added to their attractiveness. Ably edited, clearly printed, and well and neatly bound, Mr. Blakiston's 'Glimpses' should find their way into many of the places he so graphically describes.

The Elements of Geography. By Rev. B. G. Johns. 186 pp. Price 1s. London: Crosby Lockwood & Co.

Now-a-days one is so accustomed to see elementary geographies chopped up into small sections duly numbered (we had nearly said labelled) ready to be mentally swallowed the prescribed number of times a day, that it is refreshing to come across Mr. Johns' booklet. It is a first-rate *introduction* to the interesting study, and contains within its 186 pp. a very fair amount of geographical information penned in an interesting style. We, however, think the author has made a serious mistake in following the old-fashioned custom of putting questions at the end of each chapter. The space thus occupied would have been turned to infinitely more advantage by the insertion of a series of rough sketch maps say four times the size of that which appears on the page headed 'Preface to the First Edition.' It is impossible to study geography rightly without maps; every help therefore in this direction should be given. Not the least merits of the book are its size and price; it forms, if we may be allowed the expression, an excellent elementary 'pocket' geography, and may be had in an elegant binding for a shilling.

[*Continued from page* 143.

4.
Every £ in the 3 p. c. at £$90\frac{5}{8}$ brings £$\frac{24}{725}$, or £$\frac{552}{16675}$ of interest.
,, 4 p. c. at £115 ,, £$\frac{4}{115}$, or £$\frac{580}{16675}$,,

By 2d investment every £ giving a difference of £$\frac{28}{16675}$ of income.

£$\frac{28}{16675}$: £7 :: £1 : capital in 115.

$\therefore$ £$1 \times 7 \div \frac{28}{16675}$ = £4168, 15s. = $\frac{3}{5}$ of capital in $90\frac{5}{8}$, or £4168, 15s. $\times \frac{5}{3}$ = £6947, 18s. 4d., total in $90\frac{5}{8}$. Ans.

5. (*a*)
Weight of rings = 28 grs. (troy) $\times$ 1050 = 29400 grs.
= $\frac{29400}{7000}$ lbs. avoir.
= $4\frac{1}{5}$,,
Weight of box = $3\frac{1}{2}$,,

$\therefore$ total weight = $7\frac{7}{10}$ lbs. avoir.

To find the cost of carriage, the statement is:—
2240 lbs. : $7\frac{7}{10}$ :: 5s.
1 mile : 144 miles.

$$\frac{5s. \times 77 \times 144}{2240 \times 10} = \frac{5s. \times 11 \times 144}{3200} = \frac{99}{40}s. = £0,\ 2s.\ 5\tfrac{7}{10}d.$$

(*b*) 1050 rings at £$1\frac{1}{10}$ = £1155.
Insurance of £1155 at $\frac{1}{8}$ p. c. = $\frac{£1155}{800}$.

$$\begin{array}{r} £ \\ 1{\cdot}44375 \\ 20 \\ \hline 8{\cdot}87500 \\ 12 \\ \hline 10{\cdot}50000 \end{array}$$

	£	s.	d.
Cost of insurance =	1	8	$10\frac{1}{2}$
,, carriage =	0	2	$5\frac{7}{10}$
Total cost =	1	11	$4\frac{1}{5}$

FEMALES.

1. £225 : £100 :: 1 year.
$3\frac{1}{2}$: $31\frac{1}{2}$.

$$\frac{1\ yr. \times 100 \times 63}{225 \times 7} = \frac{900}{225} = 4 \text{ years. Ans.}$$

2. 1500 copies : 5000 copies :: 66 reams.
11 sheets : 25 sheets.

$$\frac{66\ reams \times 5000 \times 25}{1500 \times 11} = \frac{6 \times 10 \times 25}{3} = 500 \text{ reams. Ans.}$$

3.
$$\begin{array}{rrrcrrrcrrr} £ & s. & d. & & £ & s. & d. & & £ & s. & d. \\ 36 & 8 & 9 & : & 24 & 5 & 10 & :: & 365 & 7 & 3 \\ & 20 & & & & 20 & & & & & \\ \hline & 728 & & & & 485 & & & & & \\ & 12 & & & & 12 & & & & & \\ \hline & 8745d. & & & & 5830d. & & & & & \end{array}$$

Cancelling 1st and 2d terms by 2915, we have

$$\begin{array}{rcl} & & \begin{array}{rrr} £ & s. & d. \end{array} \\ 3 : 2 & :: & \begin{array}{rrr} 365 & 7 & 3 \\ & & 2 \\ \hline 3)730 & 14 & 6 \\ \hline £243 & 11 & 6 \end{array} \end{array}$$

: net rental; £243 11 6 Ans.

4.
	£	s.
For the £15 share he pays	19	10
For the £25 share he pays in	10	0 more.
$\therefore$ for the £32, 9s. he has paid	29	10

That is, an expense of £29, 10s. gains £2, 19s.

$\therefore$ an expense of £100 ,, $\frac{£2,\ 19s. \times 100}{£29,\ 10s.}$,

or ,, £$\frac{5900}{590}$,

,, £10. Ans.

Grammar.

(*a*) Our host replied, 'Allow me to ask the reason why your face is so discoloured.' The alchemist's servant said that he was so much employed in blowing the fire that the heat had changed his colour. They were continually working at and peering into the fire; yet, notwithstanding their industry, they could not attain their end, for the science was so far beyond their comprehension that, let them strive as they might, they could not solve the mystery. The more they tried to discover it, the more mysterious it seemed to grow; and so much time and money had been spent on it that they expected nothing else but to be left in beggary.

(*b*) *The hotë fire* illustrates the concord of *the adjective agreeing with its substantive in gender, number, and case.*

(*c*) The change that has taken place in the pronunciation of *sciênce* and *colóùr* is that these words are now accented on the *first* instead of the *second* syllable. The rule for the alteration of the accent is that in English the tendency of the language is to place the accent always towards the beginning of words. The accent placed towards the end of the word is a sign of recent introduction from a foreign language. Other examples are *licoúr, prostráte, natúre, theátre, académy.*

(*d*)

Sentence.	Subject.	Predicate.	Object.	Extensions.
(*a*) For that science is us so far beforn. (*Sub. of reason.*)	(For) that science	is beforn us	...	so far
(*b*) That we may not overtake it. (*Adv. of consequence to* (*a*).)	(that) we	may not overtake	it	...
(*c*) Although we had it sworn. (*Adv. of concession to* (*b*).)	(although) we	had sworn	it	...
(*d*) It slides away so fast. (*Adv. of cause to* (*b*).)	it	slides	...	away (*place*), so fast (*manner*)
(*e*) It will us makë beggars at the last. (*Principal.*)	it	will makë	us, beggars (*complt.*)	at the last

(*e*) PARSING.

quoth—verb, defective, indic. past, 3d pers. sing. agreeing with subj. *hostë.*
(*This verb is no longer in common use. It always precedes its subject. It is derived from O.E.* cwethan, *to say.*)

let—verb, trans. strong conj. (*let, let, let*), imper. 2d pers. sing. agreeing with subj. *thou.*
(*It may be considered also as forming with the infinitive talke the* 1st *pers. of imper.*)

talke (for *talken*)—pres. inf. of reg. verb *to talke.*
(*The -n of the infinitive is left out.*)

alchemist's—noun, masc. sing. poss. attributive to *servant.*
(*Genitive used to end in -es, but afterwards the 'e' was dropped, and the elision is marked by the apostrophe.*)

poren—1st pers. plur. pres. indic. of the intrans. verb *poren*, to pore.
(*-en used to be the plural ending of the present indicative.*)

science—noun, abstr. neut. sing. nom. subj. of *is.*
(*This word is derived from the Latin through the French, and has the accent on the last syllable.*)

us—1st pers. pron. masc. plur. obj. gov. by *beforn.*
(*Us is a dat. as well as an obj. case.*)

beforn—prep. gov. obj. case *us.*
(*This word, contracted for byforen, is now written 'before.'*)

makë—pres. infin.
(*For 'maken' A.S. inf. form.*)

Geography.

1. NOTES OF A LESSON—UNITED STATES.

(*a*) *Boundaries.*—North, British America; south, Mexico, and Gulf of Mexico; east, Atlantic Ocean; west, Pacific Ocean. *Extent.*—Greatest length, 2800 miles; greatest breadth from north to south, 1600 miles; area, 3,602,400 square miles.

(*b*) *Mountains.*—Rocky Mountains in the west; Appalachian or Alleghany Mountains in the east.

(*c*) *Rivers.*—*Mississippi* and *Missouri*, latter generally considered a tributary of the former. Tributaries of the Mississippi —*Ohio*, from the east (with its branches *Wabash, Cumberland*, and *Tennessee*), and lower down, the *Arkansas* and *Red River*, from the west. Great rivers of Pacific slope—*Columbia* or *Oregon*, the *Sacramento*, the *San Joaquin*, and the *Colorado.* Rivers of Atlantic slope—*Potomac, Susquehanna*, and *Hudson.*

(*d*) *History.*—Previous to 1765 they belonged to Britain; Stamp Act passed; 1768, affairs became threatening; 1773, taxed tea thrown into Boston Harbour; 1775, first contest at Lexington; Bunker's Hill; Siege of Boston; July 4, 1776, Declaration of Independence; General Burgoyne surrenders at Saratoga; 1781, Lord Cornwallis surrendered; 1783, independence acknowledged; General Washington first President; 1812, war with England; 1845, war with Mexico; 1861, beginning of the War of Secession; 1864, Assassination of President Lincoln; 1876, Centennial Exhibition.

(*e*) *Constitution.*—Republican form of government; President holds office for four years; Vice-President; Congress, consisting of a Senate and House of Representatives; Senate consists of two members from each state, chosen for six years, one-third of them being elected every two years; the House of Representatives elected by the people for a term of two years.

(*f*) *Trade.*—Foreign trade chiefly with Great Britain, France, British North America, Germany. *Imports* — manufactured goods, wine, colonial produce. *Exports*—raw cotton, wheat flour, tobacco, timber, agricultural produce.

Manufactures.—Cotton in Massachusetts; woollen in Pennsylvania; iron in New York and Pennsylvania; sugar in northern and middle States; india-rubber goods, machinery, agricultural implements, etc.

Great Towns.—New York, Boston, Philadelphia, Baltimore, Charleston, New Orleans, San Francisco.

2. The Atlantic Ocean extends from the Arctic Circle on the north to the Antarctic Circle on the south, having the western coasts of Europe and Africa as its eastern, and the eastern coasts of North and South America as its western boundaries. Its comparatively little interruption by islands, its great currents, and its greater extent of coast-line than all the other oceans together, are its distinguishing features. North of the equator its shores are very irregular, while south of it the coast-line is, as a rule, regular and unbroken.

The Pacific Ocean extends from the Arctic to the Antarctic Circle, the western shores of America forming its eastern, and the eastern coasts of Asia and Australia forming its western limits. Though nearly twice as large as the Atlantic, the Pacific is not by any means so important. It differs also from the Atlantic in being studded with a vast number of islands. The shores of the Pacific on the eastern side are penetrated by only two gulfs of any importance, while the western side shows a number of considerable indentations. The Pacific, unlike the Atlantic, which has a comparatively free communication with the Arctic Sea, is almost entirely landlocked on the north. The shores of the Atlantic preserve such a remarkable parallelism as to give it the name of the 'Atlantic Canal.' The long contracted basin of this ocean contrasts very strongly with the immense oval-like expanse of the Pacific.

History.

1. A very probable explanation why England has not had a second sovereign named either Stephen or John, is that they both brought so much suffering on their subjects that the name of each was detested. They were both usurpers, and the latter was one of the most worthless and cruel wretches that ever lived.

2. Cape Colony was taken by the British in 1806. Up to that year it belonged to the Dutch, who had planted a colony there in 1652. It was confirmed to this country at the treaty in 1814, and has made great progress under British protection. British Kaffraria, formerly a separate colony, was incorporated with it in 1866. Basuto Land was annexed in 1868–71. In 1871 West Griqualand, north of the Orange River, famous for its diamond-fields, was ceded to Britain, and a constitution was framed for it in 1873. Natal was made a separate colony in 1856. The Transvaal was annexed to British territory in 1848,

but the Boers rebelled lately, and by the peace concluded a short time ago they acknowledge the Queen as their suzerain.

3. The publication of debates in the House of Commons has been tolerated since the year 1771, when one of the printers who refused to appear at the bar of the House was arrested by one of its messengers. The arrest brought the House into conflict with the magistrates of London, who set aside the proclamation forbidding the publication of debates as illegal. They released the printer, and sent the messenger to prison for unlawful arrest. The House sent the Mayor to the Tower, but the sympathies of the people were so strongly in favour of the Press, that the attempt to prohibit the publication of Parliamentary proceedings dropped silently on his release at the next prorogation.

Composition.

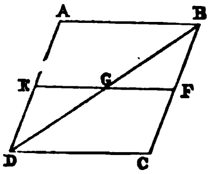
LIGHT AND ITS USES.

It is impossible to over-estimate what we owe to the sun, for without its light and heat our minds and bodies would not grow aright. A plant that grows where the light cannot reach it is bleached and feeble, and gardeners take advantage of this circumstance to blanch the stems of celery by partially burying them under the soil. A person who spends his life in mines, or even in badly-lighted rooms, becomes pale and bloodless, and is not so well protected against disease as the one who enjoys plenty of good light. People who live in manufacturing towns where the atmosphere is foggy and smoky, share but sparingly the light which struggles through such a medium. Children brought up in the houses of such towns are pale and weak, badly formed, and smaller than others of their own age who have enjoyed the sunshine. Flowers are seen to bloom best on the side next the light, and a geranium has been seen to bear only leaves when grown in a feeble light. The naturalist is aware also that if two tadpoles be taken, and one allowed to grow in the light while the other is shut up in the dark, the former will change at the proper time into a frog, but the latter will remain a tadpole. It is said that the great number of imbecile children found among the deep and ill-lighted valleys of Switzerland are the results of want of sunshine.

Euclid.

1. Let ABCD be the parallelogram, and E the given point. Draw BD the diagonal and bisect it in G. Through G draw EGF, the parallelogram shall be bisected by the straight line EGF.

BG is equal to GD, the angle BGF is equal to the angle EGD, and the alternate angles DEG, BFG are equal; therefore (I. 26) the triangles EGD, BGF are equal. Now BD divides the figure into two equal triangles, ABD, CBD. Therefore by adding BFG, EGD respectively to each of the equal trapeziums ABGE, DCFG, we have the equal trapeziums ABFE, EFCD, and therefore the parallelogram has been divided into two equal parts by the straight line EGF.—Q.E.D.



2. Prop. I. Book 2.

Let the divided line contain a linear units, and the undivided line b linear units of the same length, and let a contain $m+n+p$ linear units.

Then $a=m+n+p$.

Multiplying these equals by b;

therefore $ab=bm+bn+bp$.

That is, the product of two numbers, one of which is divided into any number of parts, is equal to the sum of the products of the undivided number and the several parts of the other.

3. Prop. IX. Book 2.

Algebra.

1. $\left(x+2+\frac{4}{x-3}\right)\left(x-2-\frac{4}{x+1}\right)$

$$=\left(\frac{(x+2)(x-3)+4}{x-3}\right)\left(\frac{(x-2)(x+1)-4}{x+1}\right)$$

$$=\frac{(x^2-x-6+4)(x^2-x-2-4)}{x^2-2x-3}$$

$$=\frac{(x^2-x-2)(x^2-x-6)}{x^2-2x-3}=$$

Work.

$$\begin{array}{l} x^2-x-2 \\ x^2-x-6 \\ \hline x^4-x^3-2x^2 \\ \quad -x^3+x^2+2x \\ \qquad -6x^2+6x+12 \\ \hline \end{array}$$

$$x^2-2x-3)\,x^4-2x^3-7x^2+8x+12\,(x^2-4. \text{ Ans.}$$

$$\begin{array}{l} x^4-2x^3-3x^2 \\ \hline \qquad -4x^2+8x+12 \\ \qquad -4x^2+8x+12 \\ \hline \end{array}$$

2. (1) $13x-12y=133$, or $390x-360y=3990$

(2) $30x-29y=167$, or $390x-377y=2171$

Subtracting, $17y=1819$

$y=107$. Ans.

Substituting 17 for y in (1),

$$13x-1284=133,$$

$$13x=1417,$$

$$x=109. \text{ Ans.}$$

(2) $\frac{39(1-x)}{4}=\frac{50x}{x+1}+3x$.

L. C. denominators $=4(1+x)$;

$$\therefore 39(1-x^2)=200x+12x(1+x),$$

$$39-39x^2=200x+12x+12x^2,$$

$$-39x^2-12x^2-200x-12x=-39,$$

$$51x^2+212x=39.$$

Completing square,

$$x^2+\frac{212}{51}+\left(\frac{106}{51}\right)^2=\frac{39}{51}+\frac{11236}{2601}=\frac{1989+11236}{2601}=\frac{13225}{2601}$$

Taking square root,

$$x+\tfrac{106}{51}=\pm\tfrac{115}{51},$$

$$x=\pm\tfrac{115}{51}-\tfrac{106}{51}=\tfrac{9}{51},\ -\tfrac{221}{51}$$

$$=\tfrac{3}{17}, \text{ or } -4\tfrac{1}{3}.$$

3. Let x=number of days he worked.

Then $40-x$= ,, ,, was idle.

$$42x-30(40-x)=960\text{d.},$$

$$42x-1200+30x=960,$$

$$72x=2160,$$

$$x=30 \text{ days. Ans.}$$

Mensuration.

1. Let x=the base.

Then $x+\frac{5}{8}x+\frac{5}{8}x=306$ ft.,

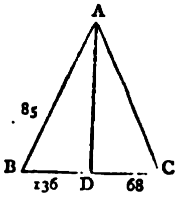
$18x=2448$,

$x=136$=base,

85=each of equal sides.

$AD=\sqrt{85^2-68^2}=51$.

Area $=DC\times AD=68\times51=3468$ sq. ft. Ans.



2. Hypotenuse

$$=\sqrt{27^2+43^2}=\sqrt{729+1849}$$

$$=2678, \text{ square on hypotenuse.}$$

Area of circle=square of diameter $\times$ ·7854, but hypotenuse of right-angled triangle=diameter;

$\therefore$ area of circle $=2678\times$ ·7854=

$$\begin{array}{r} 2678 \\ \cdot7854 \\ \hline 10712 \\ 13390 \\ 21424 \\ 18746 \\ \hline 2103\cdot3012 \end{array} \text{ sq. ft.}$$

Music.

1.

2.

Diminished 4th. Diminished 7th. Augmented 6th. Augmented 2d.

3.

——o——

Publications Received.

Agriculture—

(1) The Fields of Great Britain. Crosby Lockwood & Co.

Algebra—

(1) Cayzer's 1000 Algebraical Tests. Griffith & Farran.
(2) Mansford's Algebra. Hughes.

Arithmetic—

(1) Cayzer's 1000 Arithmetical Tests. Griffith & Farran.

Chemistry—

(1) Practical Organic Chemistry. By H. Chapman Jones. Hughes.

English Literature—

(1) Payne's Studies in English Literature. Crosby Lockwood & Co.
(2) Lays of Romance. By W. S. Ross. Stewart & Co.

German—

(1) Werner's First German Course. T. Laurie.

Maps, etc.—

(1) Imperial Map of Asia, with Handbook. W. & A. K. Johnston.
(2) Johnston's Illustrations of Light and Heat. Two Sheets, with Handbook. W. & A. K. Johnston.

Mental and Moral Science—

(1) The Mechanism of Sensation. Griffith & Farran.
(2) Glossary of Biological Terms. Griffith & Farran.

Music—

(1) Rudiments of the Theory of Music. John Heywood.
(2) Young's School Songs (Second Series). T. Laurie.
(3) A Manual of Music. Brown & Son.

Periodical Literature—

(1) Ward & Lock's Universal Instructor. Parts I., II., III., IV., V., VI. Ward & Lock.
(2) The Cambridge Examiner. Palmer.

Physical Science—

(1) Lessons on Elementary Mechanics. By P. Magnus. Longmans & Co.

Reading-Books—

(1) Glimpses of the Globe (Standard II.). Griffith & Farran.
(2) Glimpses of England (Standard III.). Griffith & Farran.
(3) Glimpses of the British Empire (Standard IV.). Griffith & Farran.

School Management—

(1) The Elementary School Manager. Isbister.
(2) Self-Education. Skeffington.

Spelling—

(1) Campbell's English Spelling and Dictation. Parts I.-IV. T. Laurie.

Writing—

(1) Cox's Practical Standard Copy-Books. Parts I.-XV. Hughes.

Engagements for May.

May 2. Medical Society of London, 'Annual Oration and Conversazione,' . . . 7.45 p.m.
Victoria Institute, 'The Philosophy of Herbert Spencer.' By Rev. W. D. Ground, . 8 p.m.
Home and Colonial Annual Meeting.
Royal Institution, Annual Meeting, . . 2 p.m.

3. Society of Biblical Archæology, . . 8 p.m.

4. Dialectical Society.
Mrs. Frances Hoggan, M.D., . . 8 p.m.
Ascham Society, 'Bythoughts on Education.' Rev. W. Boyd Carpenter, M.A., . . 8 p.m.

5. Royal Archæological Institute, . . 8 p.m.
Second Grade Art Examination. Model and Freehand.
Linnean Society, ... 8 p.m.

6. Royal Institution, 'The Land Systems of England and Ireland.' Hon. G. C. Broderick, B.C.L., ... 8 p.m.
London Institution, 'Some American Humorists.' Rev. H. R. Haweis, . . 8 p.m.
Philological Society, 'Rhaeto-Romanic Dialect.' Russell Martineau, M.A., . . . 8 p.m.
Carlyle Club, ... 8 p.m.
Second Grade Art Examination. Geometry and Perspective.

9. Geographical Society, ... 8 p.m.

10. Society of Arts, Foreign and Colonial Section, 8 p.m.
Science Examination, Mathematical Stages 1, 2, 3.
Anthropological Institute, . . . 8 p.m.
Science Examination, Acoustics, Light, and Heat.

11. Geological Society, ... 8 p.m.
Science Examination, Magnetism and Electricity.

12. Ascham Society, 'The Place of English in a Liberal Education.' Professor Henry Morley, 8 p.m.
Science Exam., Physiography.

13. Royal Institution, 'Mental Images and Visions.' Francis Galton, Esq., M.A., F.R.S., M.R.I, ... 8 p.m.
London Institution, 'Some American Humorists.' Rev. H. R. Haweis.
Astronomical Society, . . . 8 p.m.
Society of Arts, 'Burmah.' General Sir Arthur Thayre, G.C.M.G., R.C.S.I., C.B., . 8 p.m.
Science Exam., Mining, Agriculture, Mathematics, Stages 6 and 7.

14. Science Exam., Practical, Plane, and Solid Geometry.

16. Victoria Institute, ... 8 p.m.
Science Exam., Navigation and Geology.

17. Science Exam., Animal Physiology.

18. Dialectical Society. Paper, W. F. Revell, Esq., ... 8 p.m.
Science Exam., Theoretical Mechanics.

19. Science Exam., Applied Mechanics.

20. Science Exam., Inorganic Chemistry.
Royal Institution, 'Shakespeare Criticism.' Walter H. Pollock, Esq., . . . 8 p.m.
London Institution, 'Some American Humorists.' Rev. H. R. Haweis, . . 8 p.m.
Philological Society, 'President's Annual Address.' A. J. Ellis, B.A., F.R.S., . 8 p.m.

21. Science Exam., Practical Inorganic Chemistry.

23. Science Exam., Mathematics, Stages 4 and 5.
Geographical Society's Anniversary, . . 2 p.m.

24. Science Exam., Biology and Metallurgy.
Anthropological Institute, . . . 8 p.m.
Linnean Society (Anniversary), . . 3 p.m.

25. Science Exam., Elementary Botany.
Geological Society, ... 8 p.m.
Ascham Society, ... 8 p.m.

26. Science Exam., Mineralogy, Nautical Astronomy.
Society of Arts, Applied Chemistry and Physics Section, ... 8 p.m.

27. Science Exam., Organic Chemistry, Steam.
Royal Institution, 'The Artificial Production of Indigo.' Professor H. E. Roscoe, LL.D., F.R.S., ... 8 p.m.

28. Science Exam., Practical Organic Chemistry.

30. Science Forms, 400 to be sent in.
Society of Arts, Foreign and Colonial Section, 8 p.m.

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Monthly Notes.

[*The Editor will have pleasure in inserting Short Notices of Association meetings. Communications should be written on one side of the paper only, and sent early in the month.*]

NOTE.—We regret exceedingly that the Portrait and Life of John R. Langler, Esq., B.A., F.R.G.S., President of the National Union of Elementary Teachers, which was promised for this number, is unavoidably held over.

A MEETING of the Bedford and District Association of Elementary Teachers was held in St. Mary's School, Bedford (kindly lent for the occasion), on Saturday, 9th April. The president, Mr. J. Hare, of Ravenstone, occupied the chair. The greater part of the time was spent in considering the Agenda for the Twelfth Annual Conference of the National Union of Elementary Teachers to be held in Hawkstone Hall, Lambeth, on Easter Monday and the three following days. The representatives, Mr. Hare and Miss Robinson, were instructed as to which motions they were to support or oppose on behalf of the Association. There was a good attendance, and two new members were received.

DEATH OF SIR CHARLES REED.—The cause of education lost one of its warmest friends by the death of Sir Charles Reed, chairman of the School Board for London, which took place on Friday the 25th March, at his residence, Earlsmeed, Page Green, Tottenham. On the 13th he was seized with an attack of faintness, which developed into pleurisy. From this he appeared to be recovering, and the change became manifest only a few hours before it terminated in death. Sir Charles was the second son of the late Rev. A. Reed, D.D., Congregational minister, Hackney, who was a man of distinguished philanthropy, and founder of several most useful institutions which continue to exist, amongst others the asylum for idiots at Earlswood, and that for fatherless children at Reedham, Surrey. Sir Charles received his early education in a school founded by his father in Hackney, from which he passed in due time to University College, Gover St. He has occupied a prominent place among the advocates and supporters of popular education from his youth up. At twenty-five he married a daughter of the late Mr. Edward Baines, a sister of the present Sir Edward Baines of Leeds. Both these gentlemen were distinguished during many years as opponents to State education. We do not know whether Sir Charles ever agreed with his father and brother-in-law on this subject. We do know, however, that in practical efforts to promote education by voluntary effort he and they were equally zealous and assiduous. One of the results of such effort was the establishment of Hamerton Training College, in support of which we believe no Government assistance was received until after the passing of the Education Act of 1870. Sir Charles was elected in 1868 as one of the first representatives in Parliament of the then newly-constituted borough of Hackney, and in this capacity took an active part in assisting Mr. Forster to carry the Education Bill through the House of Commons. He was one of a small number of the then Nonconformist members of the House who supported with all the vigour of which they were capable those provisions of the Bill which authorized the teaching of religion in Board schools. He was re-elected member for Hackney in 1874, but owing to an informality in the ballot, he was unseated. Instead of offering himself for re-election, which he was at perfect liberty to do, he thought good to retire and make way for Mr. Fawcett, who was then elected as second member for Hackney. Sir Charles was a member of the School Board for London from its beginning. He was elected vice-president of the first Board, Lord Lawrence being president. At the beginning of the second Board, which was elected in November 1873, he was elected president, and having been twice re-elected, he continued to occupy that position and to discharge its duties with much acceptance till his death. Soon after his first appointment the honour of knighthood was conferred upon him, and in 1876 he was created an honorary LL.D. of Yale University, United States. He was president of the Judges on Education at the International Exhibitions of Philadelphia and Paris, was an officer of the Legion of Honour, and also of Public Instruction in France. At the last Parliamentary election he was chosen as the representative of St. Ives, Cornwall; and his chief object in seeking this position was that he might more effectually advance the interests of education. He has fallen in the service of the public, and Lord Lawrence and he have left to the London School Board the valuable tradition of two laborious and honourable chairmanships. Sir Charles Reed was buried in Abney Park Cemetery, on Wednesday the 30th of March. The funeral was attended by several members of Parliament, present and past members of the School Board, as well as many of the officials and teachers of the Board. There were also present representatives of various other public bodies to which Sir Charles belonged. The streets and roads between the house and cemetery were also thronged with people, evidently sympathizing spectators of the sad ceremony.

THE ELECTION OF A SUCCESSOR AS CHAIRMAN OF THE SCHOOL BOARD.—The Board having in a becoming manner expressed its sense of its loss by the death of Sir Charles Reed, as well as its sympathy with his bereaved family, at its usual weekly meeting on Thursday, April the 7th, proceeded to the appointment of a successor. Mr. E. N. Buxton, who succeeded the Rev. John Rodgers as vice-president, was cordially and unanimously chosen. Mr. Buxton

is a grandson of Sir Thomas Fowell Buxton, of anti-slavery fame. He has been a member of the Board since its establishment. During most of this period he has occupied the position of chairman of the By-Laws Committee, and has taken an active interest in the work of the Board generally. He is a gentleman of solid judgment, of large intelligence, of liberal spirit, courteous manners, and is an earnest educationist. His appointment was proposed by Mr. Heller in a very gracefully and truthfully complimentary speech, seconded by Mr. H. Goner, and supported by several other members, including Mr. Bonnewell, in terms which promise well for the comfort of the new chairman and the successful prosecution of the real work of the Board.

MEETING OF PRINCIPALS OF PRIVATE ADVENTURE SCHOOLS.—Among the various associations connected with education, and composed of persons engaged in the work, there is one which consists of principals of private adventure schools. This association held one of its meetings at Cannon Street Hotel, on Saturday the 16th April. At this meeting a paper on Government Control of Secondary Education, by Dr. W. P. Knightly, was read. It appears that the sentiments of this paper met with much acceptance from the members of the association. As therefore indicating the feelings of a not unimportant body on a subject of much educational importance, we insert the summary of the paper as reported in the *Daily News* :—'The author of the paper stated that by Act of Parliament a gigantic system was rising up amongst them, which offered to the less wealthy classes of society an education far beyond their views, with an apparatus of means which, by its unnecessary costliness, was becoming seriously burdensome to that portion of the community on which its support mainly depended. The opinion was maintained that the education of the middle classes should be no longer left to the life-giving impulse of individual enterprise, which had so long formed and fostered the national strength, but that it should be stinted and measured out by the mechanical routine of Government control. His chief reasons against such control were that it was a system of Government espionage foreign to the English mind, was an imitation of the paternal government of the Continent, and was calculated to reduce the intelligence of the people to a dead level of intellectual feebleness. They had already proceeded too far and too fast in that direction, as was evinced by the shallowness of the attainments and absence of muscularity in the mental constitution of the young men of the present day. These unhappy features he attributed to the revived approval of the public school system. He concluded by stating that it was the province of private schoolmasters to withstand the sinister influence of the views so extensively disseminated by superficial minds, and that they were not servants of committees or nominees of the State, but they should raise the tone of feeling, and develop all that was godlike and true in those committed to their charge.'

CONFERENCE OF THE UNION OF ELEMENTARY TEACHERS.—The twelfth conference of this body was held during Easter week as is usual, commencing on Monday at 2 P.M., and ending on the afternoon of Thursday. The place of meeting was Hankstone Hall, which adjoins and belongs to Christ's Church, of which the Rev. Newman Hall is minister. The usual preliminaries relating to the standing orders, etc., having been transacted, Mr. Rankilor introduced and inducted Mr. J. R. Langler, B.A., his successor as president for the year. Mr. Langler was most heartily cheered on taking the chair, and immediately commenced his address, the reading of which occupied exactly one hour. As to matter, it dealt with most of the subjects on the Agenda Paper, and which the Conference was just about to discuss. In style it was clear and vigorous, and it was read in a most graceful, unaffected, and effective manner. Mr. Langler is highly satisfied with the position to which the Union has attained, with the influence it has acquired, and is very sanguine as to its future prosperity and usefulness. In referring to the past history of the Union, he said that in 1870 it included twenty-six associations, with 400 members. At their last Conference there were 291 associations, with 11,412 members. The rate of increase had necessarily diminished as time advanced, but it could not be regarded as quite satisfactory that, whilst there were 36,332 teachers (five-sixths of whom were certificated) and 36,303 students and pupil-teachers in England and Wales, their numbers during the last year should increase only 480, making the actual membership of the Union (Dec. 31, 1880) 11,892. After stating that it was a relief to find that the new code for 1881 did not make many changes, he went on to say that the annual revision of the regulations was greatly to be deprecated, and that frequent changes, even if these were not very numerous, in the subjects of examination, in their character, or in their extent, could not be conducive to the advancement of education. The teachers' professional and social position had been greatly improved of late years. His office had now rarely stamped upon it the eleemosynary character which it formerly bore, and the rising generation were learning to honour its holder wherever its duties were efficiently discharged. Several things were, however, necessary. The whole teaching profession ought to be consolidated by the elementary teachers being included in the proposed legislation with respect to registration, and by their procuring representation on the proposed Educational Council.

At the close of the address a cordial vote of thanks was accorded to Mr. Langler for both the address and his services to the Union as vice-president during the past year. It was also resolved that the address be printed with the Annual Report of the Union. On the motion of Mr. Dawson, the Annual Report of the Executive was received and adopted. The next subject taken up was the Treasurer's Report and Balance Sheet, and Report of Auditors. One of the auditors, Mr. E. Wilkes Smith, besides performing the usual function of auditor, sent in a report in which he offered certain suggestions for the improving of the financial position of the Union. Considerable discussion arose as to what should be done with, or with respect to, this report. Ultimately it was resolved that the treasurer's and auditors' reports and the balance sheet be received, adopted, and printed with the Annual Report of the Union, but that Mr. W. Smith's report be received and printed, but not adopted.

Votes of thanks having been passed to the officers

of the Union, to the Executive Committee, and to the several standing committees for their valuable services to the Union during the past year, and the reports of the Benevolent and Provident Funds having been received, the first session was brought to a close.

At the second session, which commenced at 7 P.M., the first business was the reading of a paper by Mr. E. W. Moore, M.A., on the Teachers' Registration Bill. This paper, which was a very able one, was very severe in its condemnation of the Bill, especially on account of its exclusion of elementary teachers from the register which it proposes to establish. It was pronounced 'the flimsiest Bill ever presented for a first reading in the British Parliament.' Its title was characterized as 'misleading, if not false,' and it was asserted that 'its aim was to secure a huge scholastic monopoly.' After a somewhat lengthened discussion, characterized by much ability, and in which a strong determination was expressed to insist on the amendment of the Bill, especially in respect to the provisions obnoxious and unfair to elementary teachers, the following resolutions were unanimously adopted:—'1. That this Bill should provide for the consolidation of the whole teaching profession, and should therefore be extended so as to include all duly qualified teachers. 2. That after some fixed date no unregistered person should be allowed to take charge of any school. 3. That after some fixed date all candidates for registration be required to give evidence of proficiency in the science and art of teaching. 4. That this meeting considers it desirable that the teachers of public elementary schools should be represented on the proposed Educational Council.' It was also resolved that 'a copy of these resolutions, signed by the chairman on behalf of the Conference, be forwarded to Sir John Lubbock and to the Education Department.'

The next subject was a motion 'that an assistant secretary be appointed.' This subject was discussed with more warmth than any which had yet been brought before the Conference. First, an unsuccessful attempt was made to have this motion postponed till the question of the amount of member's subscription should be disposed of. Then it was opposed by those who favoured the alternative of providing additional clerical assistance. The vote being taken by show of hands, the chairman declared that seventy-eight had voted for, and sixty-five against. A division was then claimed, and while this was being taken, it was resolved to adjourn, when the second session was terminated. In the course of this session the chairman announced the result of the voting for vice-president to be—for Mr. Sykes, 6400; for Mr. Wild, 1026; while a few votes had been given for Mr. Russell and Mr. Park, both of whom had previously and formally withdrawn from the candidature.

At the beginning of the session on Tuesday morning, the chairman announced that the result of the division on the question of employing an assistant secretary was, that the motion that such be appointed was carried by upwards of a thousand votes. A discussion followed on the status and functions of the assistant secretary to be appointed. A motion was carried that the assistant secretary shall act under the instructions of the secretary in extending the work of the Union, and doing such other work as the Executive may direct, in opposition to an amendment that the last clause of this resolution be left out. A paper was then read on the code curriculum by the Rev. E. F. MacCarthy, King Edward's School, Birmingham. The now recognised faults of the Education Code were criticised with great ability, and condemned with great severity, and was highly appreciated by the Conference, by whom a vote of thanks to the author was enthusiastically and unanimously carried. A deputation from Scotland, consisting of Dr. Morrison and Mr. M'Kay, was received, and made short speeches expressive of the fraternal sympathy of Scotch teachers, which were listened to in a sympathetic and reciprocal spirit. Mr. A. R. O'Farrell and Mr. Barry also appeared as a deputation from Ireland for a similar purpose, and were similarly received.

On Wednesday morning an able paper was read by Mr. Heller, the secretary, on the Policy of the Union. Mr. Heller defined the *aims* of the Union to be—(1) to promote the interests of elementary education; (2) to promote those of elementary teachers. He also expressed very strongly the opinion that if it were necessary to determine which of these objects were to occupy the first place, it ought to be the former. Mr. Heller's opinion on this subject was approved of by the Conference all but unanimously.

The subject of the subscription of members was then resumed, and ultimately it was resolved that the subscription should be raised to 3s. instead of 2s. 6d., the former sum. The business of the Conference was not completed when we were obliged to go to press. All the most important subjects on the Agenda Paper had been dealt with, however, directly or indirectly. There was a public reception of the members of the Conference at 3 P.M., by the Lord Mayor at the Mansion House.

THE EDUCATIONAL EXHIBITION.—In connection with the Conference at Hawkstone Hall there was an interesting exhibition of new publications and school apparatus. The following firms were represented, the books, etc., mentioned being those to which special prominence was given by the publishers' representatives:—

Messrs. Bemrose & Sons (rep. Mr. Chadwick)—New Standard Readers, Fret-work Patterns, Binns' Registers, and Code Copy-Books.

Messrs. Blackie & Son (rep. Messrs. Nichol and Castell)—Comprehensive Series, New Geographical Readers, and Vere Foster's Copy-Books.

Messrs. Boulton & Co. (rep. Mr. Mercer)—Mr. J. S. Laurie's, and Drs. Robertson and Fernandez' Works.

Messrs. W. & R. Chambers (rep. Mr. J. C. Hall)—Meiklejohn's New Geographical Readers, Shakespeare's Plays, and Pictorial Reading Sheets.

Messrs. Collins, Sons, & Co. (rep. Mr. Pitkethley)—The Progressive Series, Collins' New Historical Readers, and Barber's Geographical and Grammatical Charts.

Mr. Cox (rep. Mr. Brown)—School Needlework Materials.

Educational Supply Association (rep. Messrs. Webber & Bowyer)—Cheap School Stationery and Certificates of Merit.

Messrs. Gill & Sons (rep. Mr. G. F. Gill)—Gill's Second and Third Geographical Readers, Adair's Excelsior Copy Books, Physiological Models, and Standard Imperial Arithmetics.

Mr. Joseph Hughes (rep. Messrs. L. D. Carpenter and H. Scheurmier)—Hughes's Standard Story Books and Cox's Copy-Books.

Messrs. Isbister & Co. (rep. Mr. Maitland)—New Geographical Readers, London Readers, and Isbister's Copy-Books.

Mr. Thomas Laurie (rep. Mr. Garrioch)—Victoria Readers, Kensington Series, Wilson's Sequels, and Hopper's Tellurium and Geographical Reader of Europe.

Mr. T. Murby (rep. Mr. Mellor)—Natural History Diagrams, Imperial Copy-Books, Robertson's Grammatical Works, Permutation Reading Frame, Chart of Geographical Terms, and Physical Maps.

National Society, Westminster (rep. Messrs. Meech and Hamilton)—New National and Art 19 c. 1 Readers, Large Wall Maps, and School Apparatus.

Messrs. Nelson & Sons (rep. Mr. H. Gibbs)—The Royal Readers, and New Geographical Readers, Simple History of England, and New Historical Readers.

North of England School Furnishing Co. (rep. Messrs. Clifford & Chapman)—Darlington Slate Board, Back Rest, School Desks, Bookcase, and the well-bound Series of Readers.

Messrs. W. Stewart & Co. (rep. Mrs. Haxby)—Stewart's Mathematical Series, and New Geographical, Historical, and Domestic Economy Reading Books, for all Standards. Art 19 c. 1.

Teachers' Bicycle Co. (rep. Mr. Colman)—New Bicycles and Tricycles.

Messrs. J. Walker & Co. (rep. Mr. W. Rice)—Elementary Atlas of Modern Geography, New Outline Maps, Drawing Books, and Walker's Series of Poets.

Messrs. Walkington & Broscomb (rep. Mr. Brown)—New Paragon Slates and Class Copy-Books.

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Query Column.

**** Communications for this column must reach the Office not later than the 15th inst., and should be addressed,* 'THE QUERY EDITOR' of the *Practical Teacher*, Pilgrim St., Ludgate Hill, London, E.C.

1. B. T. J. STANNINGLEY.—Write to Mr. James Jennings, 'Tuition by Correspondence Office,' Deptford, London.

2. K. A. MACLEAN.—Published by Chapman & Hall.

3. J. W. S., Manchester.—There is a number consisting of two digits, which is equal to 12 times the difference of its digits; and if 36 be added to it, the digits will be inverted. Required the number.

If x and y be the digits, $10x+y$ is the number, and $10y+x$ is the number when the digits are inverted;

$$\therefore 10x+y+36=10y+x;$$
$$\therefore 9(y-x)=36,\ y-x=4;$$
$\therefore$ the difference of the digits is 4.

But the number is 12 times the difference of the digits;
$\therefore$ the number is 48.

This is nothing but arithmetic. If we wished to bring it to two simultaneous equations, the first condition might be written $10x+y=12(y-x)$;

$$\therefore y=2x,\ y-x=4;$$
$$\therefore 2x-x=4,\ x=4.$$

4. Solve the simultaneous equations, $\left.\begin{array}{l}(1)\ x^2+y^2=74.\\(2)\ x+4y=33.\end{array}\right\}$

From (2) $x=33-4y$, and substituting this value in

$$(1)\ (33-4y)^2+y^2=74;$$
$$\therefore 17y^2-264y+1015=0,$$
$$(y-7)(17y-145)=0;$$
$$\therefore y=7, \text{ or } y=\tfrac{145}{17};$$
$$\therefore \text{from (2) } x=5, \text{ or } x=-\tfrac{19}{17}.$$

If the factors of the above quadratic are not evident on inspection, it should be worked in the ordinary way.

$$y=\frac{264\pm\sqrt{(264)^2-4(17)(1015)}}{34}$$
$$=\frac{264\pm\sqrt{676}}{34}=\frac{264\pm 26}{34}$$
$$=\tfrac{145}{17} \text{ or } 7.$$

Note that when either x or y is given explicitly in terms of the other, substitution is always the best method.

5. J. H. CRANBROOK.—The only pronouncing dictionary that would suit your purpose, so far as we are aware, is the *Manual of Geographical Pronunciation and Etymology*, by A. F. Foster, A.M. Bound in limp cloth, 2s. The publisher is Edward Stanford, 55 Charing Cross, S.W.

6. The number of works on botany is so large that we almost hesitate to name any particular one. The following are to our mind the best.

For a mere introduction to the subject:—

Sir J. D. Hooker's, in Macmillan's *Science Primers*. New edition, revised and corrected, 18mo. 1s.

Or Balfour's *Vegetable Anatomy and Physiology*, in Collins' Elementary Science Series. Fcap. 8vo. Illustr. 1s.

For slightly more advanced work:—

Oliver's *Elementary Lessons*. 200 Illustrations. New edition. Fcap. 8vo. Macmillan. 4s. 6d.

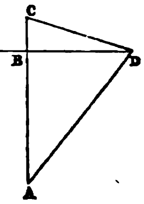
For the higher parts of the subject, and as an introduction to Cryptogamic Botany:—

Thomé's *Structural and Physiological Botany*, in Longman's Text-Books. Sm. 8vo. 600 Illustrations. 6s.

Or Lindley's *Elements of Botany*. Bradbury, Agnew. Illustr. 8vo. 9s.

We should advise J. H. to get as many of these as he can, and work straight through them in order. 'In the multitude of counsellors there is safety.' If, however, he only wish two books, we recommend him to begin with Oliver and then proceed to Thomé. But let him never forget that nature is always the best expositor of herself.

7. SEAGAN, Leeds.—In a certain lake the tip of a bud of lotus was seen a span above the water. Forced by the wind, it gradually advanced, and was submerged at a distance of two cubits. Compute the depth of the lake.



If CA be the lotus in its original position, BD the surface of the lake, AD the lotus when just submerged. The length of AB is required.

Let $CB=a(=\text{a span})$,
$BD=b(=2 \text{ cubits})$,
$AB=x$,
$AD=AC=x+a$.

Now the lotus was at first, presumably, at right angles to the lake; $\therefore$ ABD is a right angle.

$\therefore$ by Euc. I. 47, $AD^2=AB^2+BD^2$, which, expressed in our algebraical language, is $(x+a)^2=x^2+b^2$; whence, easily, $x=\frac{b^2-a^2}{2a}$. Now $b=2$ cubits$=4$ spans; $\therefore$ $x=\frac{16-1}{2}$ spans$=7{\cdot}5$ spans.

If it is desired to express this in feet and inches, we must take an approximate value for the span. The two best estimates are:—

Pyramid span, 10·944 in. (*Oxford Teacher's Bible*).
Biblical span, 9·5257 in. (Smith's *Bible Dictionary*).

Taking the mean value of these two as the correct one, we get the depth of the lake as about 6 ft. 4 in.

8. R. GIBBONS, Stockport.—One side of a triangle is half the sum of the two others; the sum of the three sides is 84 feet, and area of the triangle is 14 square yards. Find the sides.

If a, b, c be the sides, s semi-perimeter, the area is $\sqrt{s.(s-a)(s-b)(s-c)}$ (by ordinary formula).

Now we are given $a=\frac{1}{2}(b+c)$, $2s=84$, $s=42$.

$$2a=b+c,\ 3a=a+b+c=84,\ a=28 \qquad (1)$$

$$b+c=56 \qquad (2)$$

Area $=14$ square yards $=14\times 9$ square feet;

$$\therefore 14\times 9=\sqrt{42.14(42-b)(42-c)}$$
$$=\sqrt{14^2.3(42-b)(42-c)}.$$

$\therefore$ squaring and cancelling $14^2\times 3$,

$$27=(42-b)(42-c)$$
$$=42^2-(b+c)42+bc,\ \text{and}\ b+c=56;$$
$$\therefore bc=27+42.56-42^2$$
$$=27+14.42=615,$$
$$b+c=56;$$
$$\therefore b\ \text{and}\ c\ \text{are roots of}\ x^2-56x+615=0,$$
$$x=41\ \text{or}\ 15;$$
$$\therefore \text{the sides are}\ 15,\ 28,\ 41.$$

N.B.—In all quadratics where the coefficients are large, the simplest method of solution, if the roots are known integrals, is to divide by the coefficient of x^2, separate the absolute term into sets of pairs of factors, and choose the pair whose sum is $(-1)\times$ the coefficient of x.

9. ABERDONIAN, Montrose.—

$$4(ab+cd)^2-(a^2+b^2-c^2-d^2)^2$$
$$=\{2ab+2cd-\overline{a^2+b^2-c^2-d^2}\}\{2ab+2cd+\overline{a^2+b^2-c^2-d^2}\}$$
$$=\{(c+d)^2-(a-b)^2\}\{(a+b)^2-(c-d)^2\}$$
$$=(c+d+b-a)(c+d+a-b)(a+b-c+d)(a+b+c-d),$$

which may be neatly expressed as

$$16(s-a)(s-b)(s-c)(s-d)\ \text{if}\ 2s=a+b+c+d.$$

10. Prove that $x^4-(y^2-z^2)^2+y^4-(x^2-z^2)^2+z^4-(x^2-y^2)^2$
$=(x+y+z)(y+z-x)(z+x-y)(x+y-z)$.

By multiplication the dexter $=\{(y+z)^2-x^2\}\{x^2-(y-z)^2\}$
$=(2yz)^2-(x^2-y^2-z^2)^2=$ etc.

Or thus, if the expression vanishes when $y+z-x=0$, it follows that $y+z-x$ is a factor. Put $x=y+z$, and prove that expression reduces to zero. Hence $y+z-x$ is a factor, and therefore by symmetry $(z+x-y)(x+y-z)$. Now the expression is of the fourth degree, and therefore there is one other factor which must be symmetrical in x, y, and z; therefore it must be $x+y+z$. Hence, etc. This latter method, which is usually more advisable, does not in this case adapt itself well to the sum in question.

ABERDONIAN should be always ready to apply the rule $(x-y)(x+y)=x^2-y^2$, even in arithmetic, *e.g.* find difference of squares of 1239 and 1238, $1239^2-1238^2=2477$, *i.e.* $(1239+1238)(1239-1238)$.

11. EVALUATE.—$\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)(xy+xz+yz)$, when

$$x=\frac{y}{2}=\frac{z}{4},\ xyx=1,\ y=2x,\ z=4x;$$
$$\therefore xyz=x.2a.4x=8x^3=1,\ 2x=1;$$

$\therefore x=\frac{1}{2}$, $y=1$, $z=2$, and therefore the given expression is equal to $(2+1+\frac{1}{2})(\frac{1}{2}+2+1)=\frac{49}{4}$.

It should be noticed that expression

$$=\frac{(2y+yz+xz)^2}{xyz}=(xy+yz+zx)^2.$$

12. GODEFROI.—How do you account for the efficiency of a glass fire-screen, while the interior of a greenhouse is rendered much hotter than the air outside by the sun's rays alone? (Matriculation, Jan. 1881.)

This is usually accounted for by the different behaviour of glass with regard to what are ordinarily but incorrectly named 'light heat' and 'dark heat,' *i.e.* heat accompanied with light, and radiant heat. When glass is heated it emits a great quantity of radiant heat, but little or no light, and from this we may deduce that glass readily absorbs radiant heat. Experiment shows that this is really the case. Glass absorbs rays of long 'periods' of vibration, but allows those with shorter periods to pass. Now it is almost self-evident that the shorter the period the more energetic is the molecular vibration, *i.e.* the more light-rays are produced. Let us apply this to the case of the fire-screen. The heat of a fire which is glowing throughout is chiefly radiant,—at any rate it is not intensely luminous. It is therefore nearly all either reflected or absorbed by the screen. It is different with the greenhouse. The sun's heat, being accompanied with great luminosity, has a short period, and is therefore able to pass through the glass. Once inside, however, its period gradually lengthens, and it is either reflected or absorbed by the wall. In either case it is retained, and raises the interior temperature. For further information see Dischauel, Ganot, Tyndall, v. *Athermancy and Diathermancy*.

13. BLOMFIELD.—Matthiae's *Greek Grammar* will, we believe, scarcely meet the requirements of the 1st B.A. in Syntax. For its size, the best Grammar we know is Parry's, published by Longmans, 3s. 6d. For syntax we should advise Farrar's *Greek Syntax*, Longmans, 4s. 6d. The two together are amply sufficient, and not too formidable a task.

Macmillan publishes Autenrieth's *Homeric Dictionary*. The price is 6s.

Odyssey IX., so far as we know, is not yet published separately. The edition that would suit you best is *Odyssey* I.-XII., by Merry (smaller edition), Clarendon Press, 4s. 6d., annotated.

Gladstone's *Homer*, Macmillan, 1s., is invaluable to every student, for the general information it gives concerning the poet and the little that is known about him.

Bucolics and Georgics, by Archibald Bryce, published by Griffin, is a good and well-annotated edition. Price 2s. 6d.

The best annotated edition of the *De Officiis* is Holden's, published at the Cambridge Warehouse, Paternoster Row. It has marginal analyses, and an English commentary. The price is 7s. 6d. If no notes are required, the Oxford Pocket Classics, published by Parker, furnishes a reliable text at 2s.

14. PUPIL TEACHER, Ridgeway.—Translate into French, 'He has not done anything.' It should be '*Il n'a rien fait.*'

15. WALTER LE MASURIER, Holloway, N.—It does not seem to be generally known why a rapid succession of electric sparks fails to give rise to a musical note. Can you suggest an explanation?

We do not know that we can much improve on the suggestion which you make. Electric sparks are vibrations of different periods; hence different wave-lengths are propagated, and a destruction takes place through interference. At the same time, it should be remembered that electric discharges are accompanied with slight sounds, the 'brush,' for instance, always with a crackling sound. On this ground we are not sure that the absence of a musical note is not due to the lack of intensity of force. When it does become very intense, as in a thunderstorm, a very perceptible sound occurs. It may be necessary to state that the clouds in a thunderstorm have no connection with the production of the thunder, but only with its reverberation. It arises from the sonorous aërial vibrations produced by the displacement of the aërial particles suddenly repelled by the passage of the electric fluid, which thus on its course rarefies and expands, by its heat and repulsive powers, large masses of air. The elasticity of the air immediately after causing its particles to rebound, sets up a series of condensations and rarefactions throughout its mass, which thus constitute the acoustic cause of thunder. Thus we are not sure that a similar process going on in the case of every electric spark fails to produce an audible musical note because of the minuteness of the quantity of force.

16. How is it that skating becomes very laborious when the cold is exceedingly intense?

Your suggestion of *regulation* is, we think, quite satisfactory, if only you are perfectly clear as to what your terms mean.

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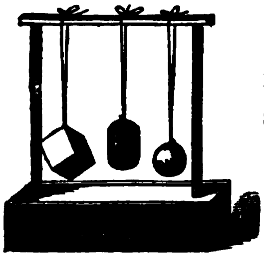

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Health at School.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),
President of the Council of the British Medical Association.

No. III.—DRAINAGE (*continued*) AND WATER SUPPLY.

TRAPS, to say the least of them, are broken reeds to lean upon. In dry seasons, the water upon which their efficiency depends evaporates, and at the very time when they might possibly be of service, viz. when putrefaction is taking place in consequence of the heat and dryness of the season, and foul gases are being evolved, the water which was in the trap has disappeared. Taken as a whole, a system of drainage which depends upon traps for its efficiency is a bad system. When sewers are dependent upon water-traps for protection against the invasion of sewer air, the protected buildings will sooner or later suffer for the confidence which has been placed in them. Sometimes, however, it is wise to choose the least of two evils, and to have a trap placed in some position, notwithstanding its defect when it is employed as the only protector. Thus, when it is necessary for the rain-water pipe to discharge itself into a sewer, the junction should be trapped. It is safer to trust to a trap at this point than to leave the rain-water pipe untrapped, or to make it loose upon a trapped grating at the level of the soil in the playground, that is, if the gully into which it discharges is connected with a closed sewer. Dipstone traps, as they are called, are very common arrangements in country districts, and country builders seem to put them in as a matter of course, and consider them marvels of perfection, but they are very objectionable. Gullies of a similar character should be prohibited in all plans for draining school buildings: any kind of arrangement which interferes with that grand canon law in all drainage work, viz. Motion, is wrong in principle, and should not be allowed except under very special circumstances. There should be nothing in the sewerage arrangements of any school which can bring excreta to a standstill, and keep it for more than a very short time in the neighbourhood of the school buildings. Indeed, from the moment when it passes into the sewer until the moment when it is exposed to those influences which are requisite to alter its chemical form, it should be kept up to the motto which is supposed to belong to the policeman, viz. that of 'moving on.' The sewage should move downward until it is acted upon by some chemical reagent or comes into contact with growing vegetable life, by means of which the organic matter is seized upon and changed into a direction which is quite opposed to the possibility of the establishment of infectious disease. This class of diseases cannot be produced if one of the constituent parts necessary for its production be absent. Changes must take place in a particular direction, in the organic matter of sewage, to allow of the multiplication of disease-producing matter. That direction is associated with fermentative developments. These developments are arrested by chemicals which prevent putrefactive changes, and place the chemical atoms of the compound in a form in which germs of disease cannot grow. But they are more certainly prevented by vegetable life, because the cells upon which plants depend for their growth and development seize upon organic matter with which it comes into contact, and alter its constituent form; so that the fermentative change which is necessary for the increase of zymotic disease cannot take place at all in that matter. Hence, the most perfect preventive service which can possibly be employed against infectious disease is, to bring the matter upon which it depends for its growth and development into contact with vegetable life as soon as possible. The excreta of human beings and of flesh-eating animals are the matters which promote the spread of infectious disease. House sewage should be hurried away from human habitations and brought into contact with vegetable life at the earliest possible moment. Chemicals may destroy the excreta if used in sufficient quantity, but in too many instances they only act as preservers of dangerous matter. They arrest putrefaction, and other allied changes; and in arresting these, they only postpone dangerous changes to some more remote period. This imperfect position cannot arise when vegetable life is the agent, for the organic matter is changed at once into harmless matter, and for ever prevented from giving rise to any kind of danger. Sewage, when once formed, is to be kept in motion until it is far away from any people who are likely to be affected by it, or is brought at once into immediate reach of the

vegetable kingdom. It is in accordance with the law of motion that sewers and house drains require to be ventilated; whenever a trap is inserted in any part of a sewer system, there should be an opening communicating with the outer air close to the trap, and between it and the main sewer. By this means air may be admitted freely into all parts of the sewer system, whether the drain pipes are above or below the level of the ground. No antagonism to this principle should be introduced into any part of the drainage of a school; so that neither air nor sewage may ever have the chance of becoming stagnant even in a short portion of a house drain. The sewers in a given school must be modified according to the character of the district in which it is situated. The water supply of the place will have a considerable influence in determining the principles to be adopted. We must look at them, therefore, from three points of view:—

1. Those districts in which there are neither sewers nor public water supply.

2. Those in which there are both sewers and water supply, and

3. Those districts in which there is a system of sewers with which the school can communicate, but in which there is no public water supply.

Schools situated in districts without either public sewers or water supply have to contend with difficulties which do not belong to town schools. It may be assumed that the district is not a very crowded one, possibly not a very populous one; and if such is the case, it may also be assumed that the inhabitants generally are not very enlightened as to the evils attendant upon bad drainage. It is the custom in the majority of country places to have a cesspool in some retired part of the grounds; it may be a lean-to attached to the least observed side of the school buildings, or it may be situated in one corner of the playground, or even within the precincts of the school itself. All these plans are bad. Cesspools in playgrounds and near to a school-house are full of danger, and are quite certain sooner or later to produce mischief to the children. They will play about the retired parts. When a child is in disgrace, or does not feel well, it will often loiter about the closet for various reasons, at a time when it is most liable to get mischief from the place itself, for disgrace as well as illness produces a depressed state of nerve-power. If there be no water supply, and if it is not possible to arrange for a continuous and abundant quantity, water-closets are not to be thought of; and yet cesspools should not be introduced except in exceptional cases, for the conditions allowing them are very rare. Earth closets such as those constructed by Moser or the Earth Closet Company should be employed. It should be the duty of some person to see that they are kept in a satisfactory state. The school superintendent should himself inspect them every day, and take care that the proper custodian does his duty. I prefer sawdust to earth for the purpose of charging the hoppers; it is cleaner. It is to be obtained in every village by an arrangement with the sawyers of the district; and when it can be obtained from pine-wood, the turpentine in it is itself a deodorizer. If mixed with dry earth, it effects its purpose still better. There is a difficulty with children, because they will play with the hopper—they like to see the action. This can only be obviated by the supervision of the teachers themselves, keeping a strict eye upon the children and frequently inspecting the places. This inspection should be made in the interests of the school. An inculcation of maxims connected with the observances of decency in these places will have a good effect upon the children in more ways than one, and is really an important part of their education, and any superintendent who fails in this duty is neglecting an important branch of a child's instruction.

The urinal is always a trouble at school. It requires to be kept very clean, and to be thoroughly washed down in warm weather every day, and even more frequently if there is infectious disease in the district. Slate is the best material of which to construct it. The floor should be impervious, and York stone or asphalt is to be preferred. It should have a trapped grating communicating with a drain to carry off the water used for washing it down, the trap in the grating being protected by a ventilator. The duty of washing down should be done as naturally as that of sweeping the floor of the school, so that it shall not be possible for the trap to get out of order. A neglect of attention to this principle is certain sooner or later to bring mischief to the children. Enamelled iron is sometimes used, but it is liable to chip; the iron oxidizes, and then it does not keep clean. The slope of the floor should be in a direction away from the person towards the urinal. The slope should be considerable. A slab inclined at an acute angle is frequently put in front to contain water. These slabs are liable to produce nuisance. It is better to have a clear space, so that little boys as well as taller ones may use the place without making a nuisance. There should be a channel cut in the slate a few inches from the wall, about two inches in depth, and that will be sufficient with a proper fall to the outfall or trap. The trap should be outside the place, and out of the way of the boys. It is better for the urinal to be open to the air on all sides, partitions being put up for decency's sake, but so situated that air may blow through and around. If covered, it should be by a roof raised some distance from the walls. The upper part is better enclosed with lattice-work rather than in brick. The closed part should not be much more than breast-high, whilst the lower part should be latticed with brick for about a foot from the ground, so as to allow ventilation in the lower part of the urinal as well as the upper. This is generally neglected, but it is necessary. There are several forms of urinals patented by different makers; but patents are out of place in school premises, and the simpler the apparatus is, the longer it will remain without becoming a nuisance; and, as I have already remarked, a continual supervision and regular cleanliness is necessary for every kind of urinal and closet. I prefer this plan to any other. If there is a water supply provided, and water is allowed to trickle down from a pin-holed pipe, children will play with the streams and try to drink from the holes. Everything likely to detain children in these places should be interdicted. Personal inspection and frequent washing by persons appointed to do it are far better than the elaborate apparatus which is often provided for the purpose of avoiding this duty. The most elaborate system requires about as much supervision as the simple one I advocate, whilst elaborate designs are also expensive. Wood-work of all kinds should be kept out of the

place, at least out of the reach of contamination. If York paving is employed, large slabs should be used, and the use of metal avoided except where absolutely necessary. Places for five persons for each hundred should be provided in the case of day-schools, whilst for boarding-schools the number should be increased to six or seven. The character of the closet must depend upon circumstances. There ought to be eight provided for each hundred children in boarding-schools, and girls require rather larger allowance than the boys, because in the case of the former urinals are not required. The arrangements provided by Moser in his form of closet meets a serious difficulty. There is a partition in the soil-pan which separates the solids from the liquids; and if these are properly looked after, they do admirably well, but like everything else connected with sewerage arrangements, they require a continuous supervision. If there is a good nuisance inspector, as there ought to be in every district, it is wise to make an arrangement with that official to visit the premises frequently, and see that the instructions of the manager are carried out. As regards the soil which has been used in the closets, there ought not to be any difficulty in arranging with some neighbouring gardener to remove it, replacing the tub which has been used by an empty one. It is necessary to arrange that the visit for this purpose should be when the places are not likely to be in use. Early in the morning before the children are moving is the best time for the purpose.

Some authorities upon school hygiene suggest that children should not be expected to go out into the open air for natural purposes connected with the use of the closet or urinal. It may be wise sometimes to provide for a covered way from the class-rooms to the W.-C's, but I strongly object to closed passages, even when swing doors are provided. These passages are certain to convey foul air into the house, and the swing doors act directly as pumps for bringing it into the class-rooms. Delicate children who cannot bear the exposure which arises in passing from the school to the outbuilding, are much more likely to be injuriously affected by the foul air of a badly constructed closet than by the exposure which arises from going out of doors for such a purpose. Children who are brought up in properly ventilated schools, are not likely to receive damage from this exposure. If there is a system of sewers into which the sewage of the school can pass, the most convenient form of drainage is by means of the water-closet. The vessel should always be constructed of earthenware, and those in which the flush of water is considerable, and which are without so-called containers, are best. The pan should be so fixed that the flush of water shall wash away the contents directly into the drain, and not drop them down into an abyss below, there to remain until another visitor comes to the place. In this latter form of closet, there is always foul air rising from the container every time the closet is used. The soil pipe attached to each closet should be properly ventilated by a pipe equal in diameter to the soil pipe; this should pass directly upwards, and be open above the level of the school buildings. This ventilator must be between the sewer and the trap of the closet. The forms of closets are very various. I have mentioned the best principle to be adopted: the flush of water should be immediate and full, not a driblet, as is too often the case. Care should be taken that the fittings connected with the water supply are made of substantial iron, and so placed as not to become frozen in long cold seasons. If they run any risk from this source, they should be encased in felt, and an arrangement made either for keeping them empty at night, or for heating the iron so that freezing shall be impossible. In some large schools a kind of trough closet is provided, allowing of use by several together, and making one flushing operation for perhaps fifty visitors. It is flushed out at regular intervals by an attendant. I think the plan is a bad one, and only to be allowed under very special circumstances. Closets which flush themselves by an action caused by the weight of the user are advantageous when well constructed, but they are very liable to get out of order and lead to expense.

The requirements of a school as regards water will not be less than eight gallons per head per day for water-closet purposes. The greatest care must be taken that the water stored for the purpose of flushing the closets shall not be drunk by the children. An ample supply of water for drinking purposes should always be provided in every school, but it should not be taken from a cistern which is kept over a closet. Pure water is very absorbing, and the gases which naturally belong to a W.-C. which is in frequent use are rapidly absorbed by the water. If this is drunk, it may be a means for spreading disease. Water for drinking purposes should, if stored at all, be stored in a cistern which has no connection with the water-closet. There should be a water supply easy of access in every playground, and yet so placed as not to be capable of being made into a means of mischievous play. It should be inculcated as a moral duty that water must be kept pure, and that to pollute the water, or to play with it, will be considered as a serious offence. If there is no public water supply, there will be much difficulty in meeting this want; but it is really important that children should be provided in some way or other with pure water, and that thus the risk should be diminished which arises from their being tempted to quench their thirst at some pond or road-side ditch. A school without a supply of water for drinking purposes fails in a part of its work. A thirsty child is not in the best condition to receive instruction, and a draught of pure water before going into school may make all the difference as regards the completion of the work, and between the exhibition of temper or of amiability. I urge all managers of schools to take care that a water supply is easy of access for the scholars, and that they have time and opportunity to take advantage of it.

Anecdotal Natural History.

No. IV.—THE MOLE.

BY REV. J. G. WOOD, M.A., F.L.S.,

Author of 'Homes without Hands,' 'Nature's Teachings,' etc.,

AND THEODORE WOOD, M.E.S.,

Joint-Author of 'The Field Naturalist's Handbook.'

ONE of the most useful, and, at the same time, one of the least appreciated of the whole animal creation, is found in the Mole (*Talpa Europæa*),

which, in spite of the inestimable benefit it confers upon agriculturists, is ranked by them as one of their worst enemies, and persecuted accordingly.

We can hardly pass through a meadow in many parts of the country without noticing a number of upright sticks planted in various parts of the field, to every one of which is suspended a mole which has been captured and slain by one of the professional trappers employed by the farmer. Now, if the farmer had taken the trouble to look below the surface, and traced the mole through its day's work, he would have found that, instead of damaging his fields and ruining his crops, the animal was in reality rendering him services which could hardly be procured for money, and that instead of untiring persecution and ruthless extermination, it ought to be protected and encouraged to the utmost of his power.

But, as with many other almost equally useful creatures, so it is with the mole, which, placed in the category of 'vermin,' falls under the ban of the farmer, and pays with its life the penalty of human ignorance.

To us who inhabit the upper world, it seems a

Common Mole, and White or Albino Variety.

strange and comfortless life this of the mole, spent in its cold, dark tunnels beneath the earth. We can hardly conceive a more wretched existence than one passed in an underground dungeon, damp and cold, and never cheered by a ray of sunlight. Yet our pity would be wasted were we to bestow it upon the mole, for no animal is better suited to its own mode of life, or more carefully adapted to obtain enjoyment from its apparently unpleasant surroundings.

Indeed, the mole is quite as unhappy when taken from the darkness, damp, and cold where it lives, as we should if placed in a subterranean dungeon and deprived of the light, dryness, and warmth which are essential to our comfort.

In every detail of its structure, we see how well the mole is suited to the life it has to lead. Cylindrical in form, its pointed snout and powerful digging-claws enable it to burrow through the soil with wonderful rapidity, while every sense is modified to suit the circumstances of its existence.

Like those of all the rest of the *Insectivora*, or insect-devouring animals, to which group it belongs, the teeth of the mole are formed for biting and seizing prey alone, and not for masticating the food, a few sharp pecking bites being the only preparation for swallowing it. It is by this structure of the teeth, also, that these animals are enabled to grasp and retain the struggling prey.

In order to fit the mole for its burrowing life, the strength of the fore-parts is developed to a wonderful degree.

The bones of the fore-limbs are stout, ridged, and considerably bowed, always a sign of great strength. The shoulder-blade, in particular, is of extraordinary length, in comparison with those of other animals, even that of the tiger or lion, either of which creatures can strike an ox to the ground with a single blow of its paw, fading into comparative insignificance beside it. In fact, if the mole were enlarged to the size of the tiger, it would be by far the stronger and more terrible animal of the two.

This extra length of shoulder-blade is necessary for the attachment of the large and powerful muscles which work the fore-limbs, and which, when the skin is stripped off, can be seen lying in thick masses, almost as hard and strong as so much steel wire.

With this wonderful development of muscular power, it is no wonder that the burrowing powers of the mole should be so great, seeing, besides, what efficient digging instruments it possesses in its fore-paws. These are set obliquely with the body, in order to secure a larger scope for their movements. They are large and powerful, not covered with fur like the rest of the body, and are furnished with long, curved, and rather flattened claws, which can penetrate the hardest earth.

These paws occasionally fulfil other offices than those of digging, for the mole is by no means a bad swimmer, and is often known to cross brooks and small streams, using the paws as paddles.

It is scarcely possible to select two creatures which present stronger contrasts to each other in point of structure than the moles and the bats, both insectivorous, but the one formed for flying in the air, and the other for burrowing in the ground.

In both animals the hind-limbs are but little required, and therefore they are feeble and comparatively insignificant, the chief distinction being in the development of the fore-limbs.

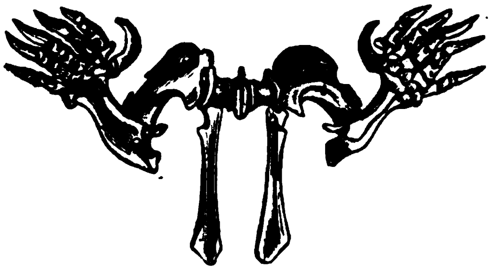
Beginning with the shoulder-blade, or 'scapula,' we find it large in both animals, but differently developed, in the bats being wide, thin, and covering many of the ribs, reaching as far as the pelvis.

In the mole, the scapula is long, narrow, very strong, and projecting upwards so as to afford attachment for the powerful muscles of the arm. The other bones are shortened and thickened in order to carry the enormous digging claws, and are deeply ridged for the attachment of the tendons which work the joints. In the bats they are attenuated to the last degree, and only one of them is capable of bearing a slight, hooked claw, solely employed for dragging itself clumsily over a level surface.

Yet the bones are the same in each case, and when the creature is dissected, the exquisitely perfect adaptation of each bone to its own office cannot but excite our highest wonder and admiration.

In the accompanying illustration the skeleton of the fore-limbs is given, so that the reader may compare the bones with those of the bat, which have already been described and figured.

The structure of the long and flexible snout is well calculated to aid the mole both in digging and also in ascertaining the nature of the soil in the places which it selects for its burrows; for, though



Common Mole. Bones of Fore-limbs.

sensitive and possessing a keen sense of touch, it is of great service in shovelling out the loosened earth—a task for which it is further suited in some species by the possession of a small auxiliary bone in the tip. This auxiliary bone is also found in the snout of the pig, which in its wild state procures a considerable portion of its food by means of the digging powers of that member.

While the animal is living, the snout is of a pinkish colour, and of a very elastic nature; it is a curious fact that, after death, it becomes hard and wrinkled, and not even the most experienced taxidermist can restore it to its pristine appearance.

Even the fur of the mole is arranged in such a manner as not to impede its progress while passing either backwards or forwards along its burrow. In order to attain this result, each hair is finest nearest the body, gradually increasing in thickness towards the tip, and is set perfectly upright, in order that its resistance may not impede the animal in its movements.

When washed perfectly clean, and viewed in a good light, the fur is seen to be beautifully iridescent, all the colours of the rainbow playing over it in succession. This is still more strongly the case in the changeable mole of South Africa (*Chrysochloris holosericea*), which will be presently mentioned.

Attempts have been made to put the skin of the mole to various uses, only one of which, however, seems to have met with any particular success. This solitary instance is in the manufacture of purses, a custom much in vogue among the peasantry in some parts of the country. The operation is simplicity itself, the head and legs of the animal being taken off, the skin of the rest of the body dried, and the bag thus formed being closed by a string round the neck. In Wiltshire these purses are in very common use. From the great warmth of the fur of the mole, it has often been thought that it might be utilized in the manufacture of garments; and the late Mr. Frank Buckland, always fond of trying experiments in anything relating to natural history, procured a number of the skins, and had a waistcoat made from them.

However, he was never able to wear it, for two reasons—the first being that it was even *too* warm, so much so as to be almost unendurable; and the second, that it was impossible to get rid of the unpleasant odour which characterizes the mole, and which persistently clung to the skins for years after they had been separated from the bodies of their owners.

So strong is this odour, and so long does it retain its power after the death of the animal, that the professional mole-catchers are accustomed, before setting each trap, to rub their hands with the body of one of their victims, which they carry with them for that purpose, in order that the wary animals may not detect the human scent about the trap, and be warned of its danger accordingly.

With the single exception of sight, the senses of the mole are developed to a very considerable extent.

Its hearing is proverbially acute. For instance, in Shakespeare's play of *The Tempest*, the deformed slave Caliban advises his friends, when they are about to rob Prospero: 'Pray you, tread softly, that the blind mole may not hear a footfall,'—a phrase which has since become almost a household word.

It is not to be supposed that this sharpness of hearing is entirely owing to the delicate structure of the mole's ear; for if it were to live in the open air, it is doubtful whether it would be able to hear better than any other animal. The fact is, that the earth is a very good conductor of sound, as may be easily proved by laying the ear upon the surface of a high road, when the noise of an approaching carriage may be distinctly heard while it is yet two or three miles distant.

Here, again, we have an instance in Shakespeare. In *Romeo and Juliet*, Act v. Scene iii., occur the lines:

> 'Under yon yew-tree lay thee all along,
> Holding thine ear close to the hollow ground;
> So shall no foot upon the churchyard tread,
> Being loose, unfirm, with digging up of graves,
> But thou shalt hear it.'

The sense, too, of scent is particularly strong, enabling the mole to detect the presence of the insects and worms upon which it preys.

The sense of touch, also, is highly developed, more especially in the snout, which the animal uses to examine the nature of the soil into which it intends to burrow. If a mole on the surface of the ground wishes to sink a fresh tunnel, it may often be seen running to and fro, and trying various places with the snout, until it has settled upon one to its liking.

Although the senses of scent, touch, and hearing are so extremely sensitive, that of sight is little more than rudimentary. On casually examining a mole, the observer would be unable to detect the presence of eyes, which are deeply buried in the fur, whence, however, they can be protruded at the will of the owner. The creature can be forced to expose them by suddenly dipping it into a pail of water, when the mole, alarmed at the unexpected immersion, instinctively protrudes them from the mass of fur with which they are usually covered, looking like very small black beads. Even when thus exposed, the vision is very imperfect, and is, indeed, hardly necessary in the subterranean existence which the animal leads.

The FOOD of the mole consists chiefly of worms, grubs, and other small creatures which it finds beneath the surface of the earth. By the mere destruction of the dreaded 'wireworm' grubs, and the larvæ of the common cockchafer, which so often devastate the crops, it renders no small service to the farmer, and this alone should protect it from the persecution to which it is so constantly subjected.

Although it finds the greater part of its food in these creatures, it by no means despises prey of a larger nature, and will eagerly devour any small bird or mouse which it may happen to meet with.

Its voracity is something extraordinary; for if kept as a pet, it is one man's work to keep it supplied with worms. It is almost impossible to describe the ferocity with which it devours its prey.

As soon as a worm is put into the cage, it detects the presence of food as if by magic, springs upon its victim, and rapidly forces it into its mouth with the fore-paws, giving meanwhile a series of rapid crunching bites, and causing the unfortunate worm to disappear with marvellous celerity.

No sooner is the first worm swallowed than it is on the look-out for a second, which is speedily disposed of in a like manner. So voracious is its appetite, that it is said to be unable to endure a fast of more than three hours. Among the peasantry it is commonly reported that the animal alternately works for three hours and sleeps for three hours, and this seems very likely to be the case.

The mole seems to suffer greatly from thirst, and always digs a series of wells in different parts of his burrows, to which he can repair when in need of moisture.

The passions of the mole are all of the fiercest nature, and when enraged, it seems utterly devoid of fear, attacking an enemy far superior in size to itself, and fighting with the greatest ferocity until death puts an end to the scene. One mole was even known to turn upon the individual who was holding it, and inflict a severe wound, refusing to quit its hold until almost killed by the teeth of its victim, no other means proving of avail.

If, by any chance, two strange moles should happen to meet in a burrow, there is but one invariable termination to their encounter. They fight, and the conqueror devours its vanquished foe.

The rather unsightly although useful 'molehills,' which are so plentiful in many places, serve to show the course which has been followed by the mole, the hillocks being merely the superabundant earth which it is obliged to throw out at short intervals. These tunnels mostly terminate in the 'fortress,' as it is termed, which is a really fine specimen of excavation, almost attaining the rank of architecture.

The situation selected is generally at the roots of a tree or large bush, where the ground is unlikely to give way above it.

The general plan of the structure is as follows:—

In the centre is a rather large circular chamber with exits at various places, which lead into a gallery surrounding it. Above this is a second circular gallery, communicating with the lower one by no less than five passages.

A large passage opening into the high road, is driven down from the lower gallery, and a large series of tunnels, radiating on all sides, and all communicating with the lower gallery, are finally constructed.

It will thus be seen that the mole, if chased by an enemy able to follow it along the tunnels, can take refuge in the fortress, pass through the centre chamber, and escape by one of the passages on the opposite side, leaving its foe bewildered in the complicated maze of tunnels. The reader must not, however, think that every fortress contains the whole of these passages and galleries; and, indeed, it is very doubtful whether any individual fortress contains both circular galleries and all the connecting passages.

The central cavity is usually filled with a quantity of moss, dead leaves, grass, etc., and is used as a bed-chamber by the mole during the colder seasons of the year. In warmer weather, however, it generally takes up its abode in one of the ordinary hillocks.

Generally at some little distance from the fortress, the female mole constructs her nest, which she builds in some large hillock, and lines with moss or dried grass. In this she brings up her young, usually from four to six in number, and provides for them until they are able to take care of themselves. Some good examples of the mole's nest may be seen in the museum at Liverpool.

The colour of the mole is usually of a blackish grey, somewhat paler upon the under side, although it varies to a considerable extent. Some specimens have been found of a pure white, and pale varieties are by no means uncommonly taken.

Putting on one side the immense benefit conferred upon the farmer by the wholesale destruction of 'wireworms,' the larvæ of the cockchafer and daddy-long-legs, which, feeding upon the roots of the crops, cause wholesale devastation, the mole is of the greatest service to the agriculturist in more ways than one.

His complicated network of subterranean passages, daily and hourly extended, not only forms a nearly perfect system of subsoil drainage, which could with difficulty be equalled by human labour, but the fresh earth brought continually to the surface from a considerable depth below the reach of the plough or spade, acts almost like manure in increasing the fertility of the land, and renders it capable of nourishing the crops with which it is planted. All that is necessary in a mole-inhabited meadow is to apply a rake to the heaps of earth, and spread them evenly over all parts of the field, in order that every yard shall receive its due share.

In yet another way does the mole prove himself the friend of the farmer, for by means of the loosened earth the air is enabled to reach the roots of the plants, where it is so much needed, and where it would have little chance of reaching were it not for the beneficent and untiring labours of the mole.

With such claims upon the farmer, it seems strange that the habits of the animal should be so little understood and appreciated, and we can only hope for the time when the spread of zoological knowledge shall have shown that both this, and many others of the so-called 'vermin,' instead of being persecuted, should be protected and encouraged to the utmost of our power.

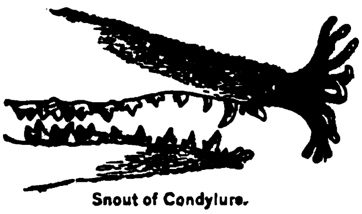
Turning to foreign countries, we find several very near relations of our common mole, some of which present very great peculiarities both in habits and form. One of the most remarkable of these animals is the Chrysochlore, Shining Mole, or Changeable Mole (*Chrysochloris holosericea*), found chiefly in the Cape of Good Hope. As before mentioned, the fur of this creature possesses a brilliant metallic radiance, changing in various lights, and far superior to that of our British example, beautiful though that is. The scientific title is singularly appropriate, the name *Chrysochloris* being formed from two Greek words signifying gold-green; and *holcserícea*, *i.e.* wholly silken, referring to the texture of the hairs.

In other ways, also, the Chrysochlore is worthy of notice. The digging paws are formed after a very singular fashion, being provided with four toes, the last of which is but of small size. The remaining three, however, are furnished with very long and powerful claws, the middle one especially being of surprising dimensions.

The jaws of this species are constructed after a perfectly unique fashion, a gap equal to the width of a tooth being left between each; so that when the jaws are closed, the teeth of each jaw fit into the interstices of the opposite one like those of a steel trap.

In the skeleton, also, are found several peculiarities, one being that there are no less than nineteen pairs of ribs. The tail is entirely wanting.

Another of the foreign moles, and one of a very extraordinary appearance, is the Radiated or Star-nosed Mole (*Astromyces cristatus*), sometimes known as the Condylure, which is found in Canada and the United States.



Snout of Condylure.

In this animal the tip of the snout is modified into a number of pink, fleshy rays, branching off in every direction, and sometimes being as many as twenty in number. These rays are retractile at will, and are supposed to aid the animal in its delicate sense of touch, and in procuring the worms, etc., on which it feeds. Another curious point about the Condylure is the size of its tail, which sometimes exceeds two and a half inches in length. The name Condylure is formed from two Greek words, the former signifying a knob and the other a tail. It was given to the animal by a person who had only seen the dry skin and not the living creature. Except for its great comparative length, the tail has little about it that is remarkable. But, when the animal is dead, the skin contracts so forcibly over the vertebræ of the tail, that the organ looks something like a row of roundish beads strung upon wire and covered with skin.

Short Historical Anecdotes.

BY REV. SIR GEORGE W. COX, BART., M.A.

(21) St. Louis of France.

Few biographies are more full of interest than the *Memoirs of Louis the Ninth of France*, better known as St. Louis, by Joinville. They bring before us a complete picture of the man in his gentleness and his firmness, in his humility and his sturdy self-respect, in his strength and in his weakness; and of the many stories which he relates about him, not a few are singularly characteristic both of Louis himself and of the age in which he lived. In one of these tales he speaks of a woman who, pleading her cause before him, burst out into the exclamation: 'You are not a king of France; you are a king only of priests and monks. It is a pity that you are king of France. You ought to be turned out.' 'You speak truly,' answered Louis; 'it has pleased God to make me king. It would have been well had He chosen some one better able to govern this kingdom rightly.' The woman was sent away with a gift of money.

(22) St. Louis—Methods of Controversy.

In matters of religion St. Louis would not hear of doubt, questioning, or argument. In his belief there could, under no circumstances, be need of any. He dwelt, Joinville tells us, with hearty approval on the conduct of a knight who, during a controversy between some Jews and the monks of the Abbey of Clugny, asked leave of the abbot to say a few words. With some difficulty he obtained the abbot's consent. Then, raising himself on his crutches, the old warrior beckoned the rabbi to draw near, and put to him one question: 'Do you believe in the Virgin Mary who bore our Saviour Jesus Christ, and that she was a virgin when she was the mother of God?' The Jew answered promptly that he believed not one word of it. 'Fool that thou art,' replied the knight, 'for daring to enter a Christian monastery when thou disbelievest these things. For this madness thou shalt now pay.' Lifting up his crutch, he struck the man a blow on the ear which felled him to the ground. His comrades fled away from the scene of controversy, while the abbot, coming forward, reproved the knight for his folly. 'Thou art the greater fool,' was the knight's answer, 'in permitting an assembly from which good Christians might, by listening to their arguments, have gone away unbelievers.' The king, Joinville adds, pointed the moral of the story by saying, 'No one, however learned or perfect a theologian he may be, ought to dispute with Jews. The layman, whenever he hears the Christian faith impugned, should defend it with a sharpened sword, which he should drive up to the hilt into the bodies of the unbelievers.'

(23) Crusade of St. Louis—Teaching by Signs.

Joinville, in his *Memoirs of St. Louis*, tells us of a woman who, in the crusade headed by that king, was seen carrying in her right hand a porringer of fire, and in her left a bottle of water. With the fire, Joinville says, she wished to burn paradise, with the water to drown hell, so that none might do good for the reward of the one, nor avoid evil from fear of the other, since every good ought to be done from the perfect and sincere love which man owes to his Creator, who is the supreme good.

(24) Boabdil of Granada and Ferdinand of Castile.

The conquest of Spain was one of the greatest and most abiding achievements of the followers of Mahomet. Not much more than four centuries have passed since the Turkish Sultan won Constantinople from the last Emperor of the East. The dominion of the Saracens in Spain lasted for nearly eight hundred years. It began with the victories of Taric ben Zeyad, who has given his name to Gibeltaric, Taric's rock, Gibraltar. The story is a tale of terrible treachery (if the legends of Count Julian have any elements of truth), as well as of awful bloodshed; but the humiliation of Roderick, the last of the Gothic kings in Spain, was almost paralleled by that of Abu Abdullah, or Boabdil, the last of the Moorish Sovereigns of Granada. That beautiful city was surrendered to Ferdinand and Isabella, of Castile on

the feast of Epiphany, the day of kings, in the year 1492. Early in the morning the king and queen set out at the head of a splendid train from the city of Santa Fé (holy faith), which they had built to serve as a blockading camp during the siege. Hearing the sound of the drums which announced their approach, Boabdil rode forth from his capital, and on coming within speaking distance of the Spanish king made a movement as if he would dismount from his horse; but this Ferdinand would not allow, and Boabdil, kissing his right arm, declared himself his subject. Later Moorish legends multiplied tales not altogether to the credit of the king, who had won for himself the name of El Zogoybi, the unlucky. One of these recorded his entreaty to the Castilian prince that no one should be allowed to pass through the gate by which he had left the city before he made the surrender, and that accordingly it was by Ferdinand's order walled up. Another related how, as he approached the spot from which the last view might be seen of the town of Granada, and which is now known as the Last Sigh of the Moor (*el ultimo sospiro del Moro*), Boabdil burst into tears; and how his mother, whose wisdom and resolution had during the whole of his reign been the chief support of his tottering power, exclaimed, 'Thou doest well to weep as a woman over what thou couldst not defend as a man.' Boabdil soon crossed into Africa, and there the prince, who had not found courage to die in defence of his own country and kingdom, fell, it is said, in the attempt to beat off the enemies of the sovereign who had given him a home after his expulsion from Spain.

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'How I teach Arithmetic.'

(*Continued from page 122.*)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

(*f*) Division of fractions naturally follows multiplication, and the principle of the operation may be comprehended by the scholars if carefully explained. Example :—Divide $\frac{3}{4}$ by $\frac{2}{3}$. A little oral questioning and explanation would draw from the children what is really required. How many times is $\frac{2}{3}$ contained in $\frac{3}{4}$? Suppose we take a shilling, then $\frac{3}{4}$ of it is 9d., and $\frac{2}{3}$ of it (1s.) is 8d., and the latter is contained in the former $1\frac{1}{8}$ times. In working the exercise on the board we might first, as in addition and subtraction, bring the fractions to a common denominator—$\frac{9}{12}$ and $\frac{8}{12}$, then as they are the same kind of parts (12ths), we can divide the 9 by the $8 = 1\frac{1}{8}$. Again, show that $\frac{2}{3}$ besides being considered as 2 parts out of the 3 into which the integer (unit) is supposed to be divided, it may also be considered as 2 divided by 3, $\frac{4}{5}$ as 4 divided by 5, $\frac{5}{8}$ as $5 \div 8$, etc.; so that these three expressions—divide $6\frac{1}{2}$ by $2\frac{3}{4}$, $6\frac{1}{2} \div 2\frac{3}{4}$, and $\dfrac{6\frac{1}{2}}{2\frac{3}{4}}$, all denote the same operation. Now $\frac{3}{4} \div \frac{2}{3}$ means that $\frac{3}{4}$ is to be divided by the third part of 2. To divide a fraction by any integer (as 2), we multiply the *denominator* by that figure, thus virtually making the parts half the previous size, hence $\frac{3}{4 \times 2} = \frac{3}{8}$; but $\frac{3}{4}$ was only to be divided by the *third* part of 2—not by 2; then as we have divided by three times as much as is required, we must now multiply the result obtained by 3,—then $\frac{3 \times 3}{8} = \frac{9}{8} = 1\frac{1}{8}$, the same result as before. Let us now retrace our steps and see what operations we have performed on the $\frac{3}{4}$. First, we multiplied the denominator (4) by the numerator (2) of the divisor, and then we multiplied the numerator of the result obtained ($\frac{3}{8}$) by 3; that is, when expressed as one operation—$\frac{3 \times 3}{4 \times 2} = \frac{9}{8} = 1\frac{1}{8}$—we virtually ***invert the divisor and proceed as in multiplication.***

(*g*) Now, if not at a previous stage, reduce fractions to their lowest terms or simplest form. We would here remark that the various stages in working fractions given above, or those to follow, need not necessarily follow in any exact determinate order; but we are following somewhat the order in which *we* generally take them. Let the scholars clearly see what 'lowest terms' really means—simplest form of representation. Show that $\frac{20}{40}$, $\frac{10}{20}$, $\frac{5}{10}$, and $\frac{1}{2}$ all denote the same fractional part, and that $\frac{1}{2}$ is the simplest form. A little intuitive inspection of the numerator and denominator will often, perhaps generally, suffice—especially when the number of figures is only small—to reduce a fraction at once, or by successive steps, to its lowest terms. Thus $\frac{24}{36} = \frac{2}{3}$, the two numbers being divisible by 12; $\frac{55}{70}\,(5) = \frac{11}{14}$, $\frac{132}{180}\,(12) = \frac{11}{15}$, $\frac{168}{224} = \frac{42}{56} = \frac{6}{8} = \frac{3}{4}$. We now take the formal method of finding the Greatest Common Measure—G. C. M. as it is generally expressed, the theory of which, however, we shall waive, at least for the present, as it is somewhat difficult to make simple, except algebraically. From the exercise worked out below, the children will notice that the greater number is simply divided by the lesser one, and each divisor by its succeeding remainder till no remainder is left; the last divisor (48) being the G. C. M. Bring $\frac{1296}{1536}$ to its lowest terms :—

```
1296)1536(1
     1296
     ----
      240)1296(5
          1200
          ----
            96)240(2
               192
               ---
             48)96(2
                96
                --
```

Then dividing the numerator and denominator each by 48, we have $\frac{1296}{1536} = \frac{27}{32}$. Ans.

N.B.—The above, and a few previous exercises, are worked out chiefly as aids to those who may be studying arithmetic without the help of a teacher.

(*h*) Simplify *complex* fractions. These were slightly touched upon in working the exercises in Compound Practice, but require further comments. Explain that the word is the opposite of simple—difficult, intricate, and that to work such fractions they must first be simplified. They may be defined as fractions that have a fractional part in their numerator or denominator, or in both—$\dfrac{3\frac{1}{4}}{8}$, $\dfrac{7}{9\frac{1}{5}}$, $\dfrac{6\frac{2}{3}}{10\frac{7}{12}}$. Explain clearly what each of these fractions denotes,—that the first means $3\frac{1}{4}$ parts out of 8, that is, bringing both to fourths, 13 out of 32,—thus $\dfrac{3\frac{1}{4}}{8} = \dfrac{13}{32}$. The third denotes $6\frac{2}{3}$ parts of $10\frac{7}{12}$, or bringing the $\frac{2}{3}$ to 12ths, $6\frac{8}{12}$ out $10\frac{7}{12}$;

then bringing both numbers to twelfths, 80 out of 127; —expressed methodically thus: $\frac{6\frac{2}{3}}{10\frac{7}{12}} = \frac{6\frac{8}{12}}{10\frac{7}{12}} = \frac{80}{127}$. Another, *e.g.*, $\frac{8\frac{3}{8}}{11\frac{5}{12}} = \frac{8\frac{9}{24}}{11\frac{10}{24}} = \frac{201}{274}$.

Under each of these heads as we proceed, a number of *short* exercises should be dictated or worked on slates from the board, first requiring simply the operation we have just explained, and then also one or more of the operations previously given. Example: $\frac{2}{3} + 4\frac{3}{5} + \frac{3}{4}$ of $\frac{5}{6} + \frac{3}{4}$ of $2\frac{1}{2}$. First simplifying the two compound fractions, we have $\frac{\cancel{3}}{4}$ of $\frac{5}{{}_2\cancel{6}} = \frac{5}{8}$, and ($\frac{3}{4}$ of $2\frac{1}{2}$) = ($\frac{3}{4}$ of $\frac{5}{2}$) $= \frac{15}{8} = 1\frac{7}{8}$. Then we have $\frac{2}{3} + 4\frac{3}{5} + \frac{5}{8} + 1\frac{7}{8}$, in which the fractions $= \frac{332}{120} = 2\frac{92}{120} = 2\frac{23}{30}$, to which add the 5 (4 + 1) and we have $7\frac{23}{30}$. Another example:—Add together $\frac{4}{5}$ of $6\frac{3}{8}$ and $\frac{2\frac{1}{2}}{4\frac{3}{5}}$, then divide the sum by $\frac{2}{3}$ of $2\frac{3}{10}$. We will work this exercise out fully and more formally:—

$$\frac{\cancel{4}}{5} \text{ of } \frac{51}{{}_2\cancel{8}} = \frac{51}{10} = 5\frac{1}{10} = 5\frac{23}{230}$$

$$\frac{2\frac{1}{2}}{4\frac{3}{5}} = \frac{2\frac{5}{10}}{4\frac{6}{10}} = \frac{25}{46} = 0\frac{125}{230}$$

$$\underline{5\frac{148}{230}} = 5\frac{74}{115}, \text{ Sum.}$$

$$\frac{\cancel{2}}{3} \text{ of } \frac{23}{{}_5\cancel{10}} = \frac{23}{15}, \text{ Divisor.} \quad 5\frac{74}{115} = \frac{649}{115}.$$

$$\text{Then } \left(\frac{649}{115} \div \frac{23}{15}\right) = \left(\frac{649}{\underset{23}{\cancel{115}}} \times \frac{\overset{3}{\cancel{15}}}{23}\right) = \frac{1947}{529} = 3\frac{360}{529}. \text{ Ans.}$$

We will now proceed to further elementary operations. (*i*) How much is £$\frac{5}{9}$? Here we simply bring the £ to shillings and pence by multiplying,—£$\frac{5}{9} \times \frac{20}{1} = \frac{100}{9}$s. $= 11\frac{1}{9}$s. = 11s. $1\frac{1}{3}$d. Bring $\frac{7}{12}$ ton to cwts. qrs. etc. $\frac{7}{12} \times \frac{20}{1} = \frac{140}{12} = 11\frac{8}{12} = 11\frac{2}{3}$ cwt. = 11 cwts. $2\frac{2}{3}$ qrs. = 11 cwts. 2 qrs. $18\frac{2}{3}$ lbs. = 11 cwts. 2 qrs. 18 lbs. $10\frac{2}{3}$ oz. Ans.

(*j*) Bring 3s. $3\frac{3}{4}$d. to the fraction of a £;—bringing both to farthings we have 3s. $3\frac{3}{4}$d. = 159, and a £ = 960, hence the former is of the latter $\frac{159}{960} = \frac{53}{320}$. Ans. Bring 2 days 13 hours 40 minutes to the fraction of a week;—first bring both to periods of 20 minutes or thirds of an hour.

days	hrs.	min.	days
2	13	40	7
24			24
61			168
3			3
185			504

Hence the fraction is $\frac{185}{504}$. Ans.

(*k*) Bring $\frac{3}{8}$ of a shilling to the fraction of a £. We can work this exercise by method (1) by finding that $\frac{3}{8}$s. $= 4\frac{1}{2}$d., and then bringing it to the fraction of a £,—$\frac{4\frac{1}{2}}{240} = \frac{9}{480} = \frac{3}{160}$. Ans; (2) the shorter method, as a *whole* shilling is $\frac{1}{20}$ of a £, then $\frac{3}{8}$s. is $\frac{3}{8}$ of $\frac{1}{20} = \frac{3}{160}$. Ans. What fraction of a guinea is $\frac{4}{7}$ crown? By second method, as a whole crown is $\frac{5}{21}$ of a guinea, then $\frac{4}{7}$ is $\frac{4}{7}$ of $\frac{5}{21} = \frac{20}{147}$ guinea. Ans. Bring $\frac{2}{9}$ yard to fraction of a foot. Here we simply multiply by 3 to get yards to feet, then $\frac{2}{{}_3\cancel{9}} \times \frac{\cancel{3}}{1} = \frac{2}{3}$ foot. In bringing a fraction of one denomination to the fraction of another, show that we really proceed in the same manner as if they were whole numbers; thus to bring inches to feet we divide by 12, hence to bring a fraction of an inch to the fraction of a foot, we divide by 12,—$\frac{2}{3}$ inch $\div 12 = \frac{2}{3} \times \frac{1}{12} = \frac{2}{36} = \frac{1}{18}$ foot. To bring feet to inches we multiply,—$\frac{1}{20}$ foot $\times 12 = \frac{1}{20} \times \frac{12}{1} = \frac{12}{20} = \frac{3}{5}$ inch.

(*l*) What fraction of $\frac{7}{8}$ is $\frac{2}{3}$? or, $\frac{2}{3}$ is what fraction of $\frac{7}{8}$? Here we are bringing *one fraction to the fraction of another*. Bringing both to the same denominator, we have $\frac{2}{3} = \frac{16}{24}$ and $\frac{7}{8} = \frac{21}{24}$; hence the result is $\frac{16}{21}$, as the 16 and the 21 are the same kind of parts—24ths, $\frac{7}{12}$ is what fraction of $\frac{7}{9}$? Here $\frac{7}{12} = \frac{21}{36}$ and $\frac{7}{9} = \frac{28}{36}$, hence we have $\frac{21}{28} = \frac{3}{4}$. $3\frac{5}{6}$ is what fraction of $6\frac{2}{5}$? Here we only express as a fraction and simplify,—$\frac{3\frac{5}{6}}{6\frac{2}{5}} = \frac{3\frac{25}{30}}{6\frac{12}{30}} = \frac{115}{192}$.

(*m*) Bring $\frac{7}{12}$ to a *fraction whose denominator* is 60. Here $\frac{1}{12}$ is $\frac{5}{60}$, hence $\frac{7}{12} = \frac{35}{60}$; or, as the denominator (12) requires multiplying by 5 to give the new denominator (60), we multiply the numerator (7) by the same number (5), and we have $\frac{35}{60}$. Bring $\frac{3}{5}$ to a fraction whose denominator is 42. Here $42 \div 5 = 8\frac{2}{5}$, that is, the denominator of the given fraction requires multiplying by $8\frac{2}{5}$ to give 42, hence the numerator (3) must also be multiplied by $8\frac{2}{5}$ ($8\frac{2}{5} \times 3 = 25\frac{1}{5}$), hence the result $\frac{25\frac{1}{5}}{42}$. Impress well that multiplying the numerator and the denominator by the same number does not affect the *size* of the fraction, being still the same. We will now simplify the fraction obtained, and thus prove it to be correct,—$\frac{25\frac{1}{5}}{42} = \frac{126}{210} = \frac{3}{5}$, as 42 will divide them. Bring $\frac{11}{16}$ to a fraction whose *numerator* is $24\frac{1}{2}$. Here elevens in $24\frac{1}{2} = 2\frac{5}{22}$, which, multiplied by $16 = 35\frac{14}{22} = 35\frac{7}{11}$, hence the result is $\frac{24\frac{1}{2}}{35\frac{7}{11}}$, which simplified $= \frac{24\frac{11}{22}}{35\frac{14}{22}} = \frac{539}{784} = \frac{77}{112} = \frac{11}{16}$, the fraction we began with. In order to impart a concreteness and reality in teaching fractions, as well as a familiarity and expeditiousness in treating them, at every stage I give a large number of short exercises to be worked mentally, having the board in front of the class—as indeed for every lesson of whatever kind—for any special explanation when required. The following is a verbatim copy of two such lessons given this day (April 6)—(*a*) in the morning, (*b*) in the afternoon. (*a*) Bring $\frac{6}{10}$ to simplest form; $\frac{15}{20}$; $\frac{16}{20}$; $\frac{24}{60}$; $\frac{36}{84}$; $\frac{17}{51}$; $\frac{22}{77}$, etc. Is $\frac{5}{8}$ more or less than $\frac{1}{2}$? How much more? Find $\frac{1}{8}$ of a £; $\frac{1}{8}$ of a shilling; $\frac{1}{8}$ of a crown; $\frac{1}{8}$ of a guinea; $\frac{1}{8}$ of a cwt.; $\frac{1}{8}$ of a ton, etc. Is $\frac{15}{16}$ more or less than $\frac{3}{4}$? How much more? Find $\frac{3}{16}$ of a £; $\frac{3}{16}$ of a guinea; $\frac{7}{16}$ of a crown; $\frac{11}{16}$ of half a crown, = 1s. $8\frac{5}{8}$d.; $\frac{9}{16}$ of a ton, = $11\frac{1}{4}$ cwt., etc. Add together $\frac{1}{2}$ and $\frac{1}{3}$; $\frac{5}{6}$ is how many 60ths? How many 300ths? $\frac{1}{4} + \frac{3}{10}$; $\frac{2}{3} + \frac{5}{8} + \frac{7}{24} = 1\frac{7}{12}$; $\frac{5}{6} + \frac{11}{16} = 1\frac{25}{48}$. How much is £$\frac{25}{48}$? = 10s. 5d.; $\frac{2}{3} + \frac{11}{12} + \frac{7}{18} = 1\frac{35}{36}$. How much is $\frac{35}{36}$ of a guinea? = £1, 0s. 5d.; $\frac{3}{8} + \frac{7}{10} + \frac{17}{20}$, $= 1\frac{37}{40}$, $\frac{37}{40}$ of a £?

$\frac{2}{3} - \frac{1}{2}$; $\frac{4}{7} - \frac{2}{5}$; $\frac{7}{10} - \frac{5}{12}$; $\frac{14}{15} - \frac{7}{12}$, $= \frac{21}{60} = \frac{7}{20}$; $4\frac{5}{8} - 2\frac{2}{5}$, $= 2\frac{9}{40}$; $6\frac{3}{8} - 2\frac{3}{4} = 3\frac{5}{8}$; $7\frac{3}{10} - 3\frac{11}{15} = 3\frac{17}{30}$, etc.

Multiply $\frac{3}{5}$ by $\frac{5}{9}$, $\frac{1}{3}$ of £2, 10s., = 16s. 8d.; $\frac{7}{8} \times \frac{4}{15}$, $= \frac{7}{30}$,—how much less than $\frac{1}{4}$? $1\frac{1}{4} \times \frac{3}{8}$, $= \frac{15}{32}$,—

$\frac{15}{32}$ of a £ = 9s. 4½d. Here explain that $\frac{1}{32}$ is $\frac{1}{4}$ of $\frac{1}{8}$, and as £$\frac{1}{8}$ = 2s. 6d., £$\frac{1}{32}$ = $\frac{1}{4}$ of 2s. 6d. = 7½d.; $3\frac{7}{10} \times \frac{4}{5} = 2\frac{48}{50} = 2\frac{24}{25}$.

Divide $\frac{3}{4}$ by $\frac{5}{6} = \frac{9}{10}$; $\frac{4}{5} \div \frac{3}{8} = \frac{32}{15} = 2\frac{2}{15}$,—how much is $2\frac{2}{15}$ crowns; $1\frac{3}{4} \div \frac{3}{5} = 2\frac{11}{12}$,—how much is £$\frac{11}{12}$? The lesson (*a*) which occupied about half an hour was closed with a more general question in mental arithmetic. What will 20 stone (each 14 lb.) of bacon cost at 9¼d. a lb.?—9¼d. × 14 = 10s. 9½d. a stone, then 20 stone at 11s. = £11, less 20 times 2½d. (4s. 2d.) = £10, 15s. 10d.

(*To be continued.*)

Practical Lessons on Insect Life.

BY THEODORE WOOD,

Joint-Author of 'The Field Naturalist's Handbook.'

II.—THE METAMORPHOSES OF INSECTS.

AS was mentioned in the preceding article, every insect passes through a series of changes, or more properly speaking, *metamorphoses*, before arriving at its perfect condition. These stages, three in number, are known as the egg; the larva, grub, or caterpillar; and the pupa, nymph, or chrysalis, the last of which terms, however, is only employed in the case of certain butterflies. We will now proceed to follow the insect through these developments.

In the first place, of course, we have to deal with the egg. In colour, size, and shape, the eggs of insects vary to a most wonderful degree, scarcely two forms being alike, and those of the most closely allied species often being totally different from each other. Some are plain, others chased and sculptured, covered perhaps with a raised network of wonderful intricacy, and enriched with all the colours of the rainbow. Some are round, others oval, square, oblong, or pear-shaped, while there is no limit to the patterns displayed upon them.

In point of numbers and situation, too, the eggs vary very greatly. A very curious arrangement is found in the common gnat.

The eggs of this insect greatly resemble a small skittle in shape, and are fastened together in considerable numbers, the whole batch forming a very perfect boat, which floats upon the surface of the water, and which cannot be upset or sunk by any accident. Even when forced beneath the water, it rises again to the surface as soon as it is released, and emptying out the water it has taken in, floats uninjured as before. In fact, the structure irresistibly reminds the observer of the most perfect life-boat which can possibly be imagined. These egg-boats, which are about the size and shape of a carraway seed, may be found in numbers in almost any rain-water tub throughout the summer.

Eggs of Gnat.

As a general rule, the eggs are laid by the parent insect either upon or near the food of the future larvæ, and after a lapse of time varying according to the insect, the enclosed grubs break through their cell and make their way into the outer world.

Almost as soon as they are hatched, the young larvæ begin the grand business of their lives, namely, eating, and in many cases make their first meal upon the empty egg-shell from which they have just emerged. From that time until their change into the pupal condition, they eat almost without cessation; and it has been computed that an insect, during this part of his existence, consumes more than one hundred thousand times his whole weight in food. And the reason is this, that the whole growth of the future insect takes place while it is in the larval state. It is an invariable rule that no insect ever grows when once it has attained its perfect condition, in spite of the popular notion to the contrary. The general idea is, that all small insects are necessarily young, and that as they grow older they will increase in size. So, a house-fly is considered to be merely a juvenile blue-bottle, and a gnat is expected to develop in due course of time into a daddy-long-legs, and so on, and it is often very difficult to persuade people to the contrary.

Another argument frequently brought forward in favour of the growth of insects is, that one often sees specimens of the same insect varying greatly in point of size. This is true enough; but both being perfect insects, will remain of the same size until they die; and it would be as reasonable to infer that the smaller might attain the dimensions of the larger, as it would be to state that a dwarf would grow into a giant. There are large insects and small insects, just as there are large and small men.

Now, taking into consideration the enormous quantities of food which a caterpillar requires, it necessarily follows that his increase in size must be proportionately rapid. And there is this drawback, that after a certain degree the skin will expand no further, and, although the creature is still obliged to continue eating, becomes most inconveniently tight. Now what is he to do? Eat he must, and his skin will stretch no further.

There is only one thing for him to do, namely, to burst, and this he accordingly does. The old skin splits down the back, and after a little trouble the caterpillar, clad in a bright new covering, crawls out from his old integument, which, as often as not, he immediately devours. No sooner has he recovered from his exertions than he again begins feeding, and continues to do so until his increase in size renders necessary another change of garments.

This operation takes place as a rule from four to six times during the life of the caterpillar, each operation consuming from twelve to twenty-four hours.

The forms of the larva are as various as those of

Larva of Tiger Moth.

the egg. We can hardly take a country walk in the early summer without noticing on the leaves of the nettle a number of brown hairy caterpillars, gener-

ally known as 'woolly bears.' These will in course of time develop into the well-known Tiger Moth. A little farther on, perhaps, we may find a group of black caterpillars thickly covered with stiff spines, which will later on become 'Peacock' Butterflies. Beneath the leaves, or hiding at the roots of the weeds, may be dug out a variety of perfectly smooth caterpillars, belonging to various moths. From almost any tree we may knock out a number of thin, stick-like objects, generally hanging at the ends of long silken threads, and which are also caterpillars.


Caterpillar of Geometer Moth.

Then, a little later on in the year, will very likely be seen the larvæ of some of the Hawk Moths, such as the one represented in the accompanying illustration, and which are armed with a long curved horn at the end of the body, together with many more far too numerous to mention.

The larvæ of other orders of insects, too, present still other forms; but as merely to describe some of the more conspicuous would more than fill the entire space assigned to this article, I shall confine myself to those of the more generally known butterflies and moths.

Upon examining the structure of one of these caterpillars, it will be seen that it possesses all the chief characteristics of the insects. It is now, just as in the perfect state, composed of thirteen segments, and the legs correspond in number.

Larva of the Privet Hawk Moth.

The organs of the various senses are not developed to an equal degree with those of the perfect insect. Instead of the enormous compound eyes, with their thousands of lenses, a caterpillar is limited to a few simple ones, twelve in number, which are placed six upon each cheek close to the mouth, and are so highly convex that they can convey no impression to the optic nerves unless brought almost into contact with an object. The antennæ, too, are very small.

Besides the six true legs, which answer to those of the perfect insect, and are placed upon the same segments, a caterpillar is furnished with several false legs, or claspers, varying from four to ten in number. The difference between the two forms is very marked. The true legs are jointed, just as is the case in the perfect insect, and are provided with hooks


Legs of Caterpillar.

or claws for the purpose of obtaining a firm foothold. The claspers, however, are nothing more than mere fleshy pads, surrounded by a circle of small but strong hooks, with the points directed inwards, and formed in such a manner that the air can be exhausted and a vacuum formed, just as is the case in the well-known 'sucker,' so common as a toy. The grasping power of these claspers is very great, and it is quite impossible to forcibly remove many larvæ from their footing without either severely damaging or killing them outright.


Clasper of Caterpillar.

In the larvæ of the *Geometræ*, or Looper Moths, the three first pairs of claspers are wanting, the remaining two pairs being situated at the very end of the body, and in consequence the caterpillars proceed in a very extraordinary manner. Grasping firmly the leaf or twig upon which it is resting with the true legs, the creature arches its body double, plants the four claspers immediately behind the feet, and taking a firm hold with them, extends the body to its utmost length in front. A second grasp is then taken with the legs, the body arched, and the claspers drawn up as before, and so on.


Geometer Larva. Mode of Walking.

Larvæ of Geometer Moth.

These larvæ have a curious habit when at rest of grasping a branch by the claspers alone, and stretching out the body at right angles to it, when from their colour and markings they bear so close a resemblance to a small twig that the most practised eye will often fail to discern them.

The interior anatomy, also, of a caterpillar is well worthy of examination. As a general rule, people do not seem to think that caterpillars have any internal organs, and this popular idea was well summed up by a gentleman who, on seeing one dissected for the first time, was astounded, and said that until then he had always thought that they were 'nothing but skin and squash'!

Living practically for no other purpose except eating, the interior is almost entirely occupied by the digestive organs, and upon opening a larva the first idea would probably be that it was all stomach,

with a coating of fat. And, in point of fact, the stomach occupies about nine-tenths of the available space, the rest of the digesting organs being very slight.

The circulatory nerves and respiratory systems are much the same as in the perfect insect, but are more easily examined.

A point of the structure of the larva not possessed by the perfect insect is found in the silk glands. These are two in number, one upon each side of the body, and are provided with ducts, which unite in the spinneret, an organ of the simplest description.

The silk, while still contained in the glands, is merely a rather thick, viscous fluid. When about to make use of it, the caterpillar places the spinneret in contact with some object, exuding at the same time a drop of the liquid, and sharply withdraws it. The silk immediately hardens upon exposure to the air, and is drawn out into an exceedingly fine but strong thread, which is able to sustain the whole weight of the caterpillar without giving way.

This silk is used for various purposes. At the approach of danger, many species of caterpillars allow themselves to fall from the branches and hang at the end of their threads until it is past, trusting to their resemblance to pieces of twig to deceive any hungry bird. Others, gregarious in their habits, spin huge webs in which to reside; others, again, bend the edges of leaves together and fasten them by its means. Some few, such as the larvæ of the well-known Puss Moth (*Dicranura vinula*), construct a silken pad as a foothold for the claspers. But its chief use is in forming the cocoon, the common silk-worm being as good an example as could be desired. It is not always used alone, many insects mingling scraps of wood, bark, etc., with it, and forming a cocoon almost hard enough to turn the edge of a knife.

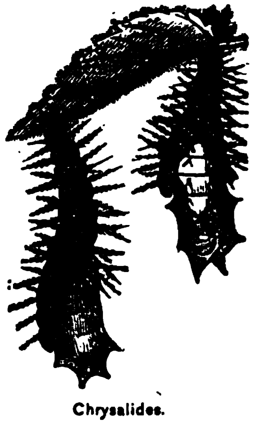
The time passed in the larval condition varies according to the insect, and is also much influenced by the condition of the weather, a warm season accelerating and a cold one retarding the growth. Some insects pass through the whole of their development in a few hours, while others, such as the Goat Moth (*Cossus ligniperda*), remain in the larval state alone for upwards of three years.

During all the earlier stages of their life, insects seem to possess an almost unlimited power of enduring cold. Caterpillars have been exposed to a temperature of some twenty or thirty degrees below zero, and have been frozen so hard that, when touched, they snapped asunder like glass; yet, upon the surrounding atmosphere being raised to the normal temperature, they revived, and seemed none the worse for their experience. Many pupæ, too, which lie fully exposed to the elements during the winter, will pass through the severest frosts without injury. It is often said that a cold winter will be good for the crops, as great numbers of the insects which devour them will be killed by the cold. In reality, however, it is rather the other way; for, while the insects are uninjured, the small birds which prey upon them perish in hundreds for want of food, so that, when the warmer weather arrives, the insect pests perform their ravages comparatively untroubled by their feathered enemies. Wet, however, insects cannot endure, and a very damp autumn always produces a most perceptible effect upon the abundance of insects during the ensuing summer.

The food of larvæ is as varied as their forms. There is scarcely a plant or tree which does not afford sustenance to many caterpillars, either by means of the foliage or the wood itself. Even the very roots furnish food to many species. Such repulsive substances as carrion, the droppings of animals, etc., are the resort of thousands of insects, to whose unceasing labours we are indebted for the prevention of many noxious diseases.

In fact, there is hardly any place in which insects may not be found, or any substance upon which their larvæ do not feed.

Some two or three days before its change into the pupal condition, the caterpillar ceases feeding, and becomes sluggish and irritable. It then seeks a place in which to undergo its transformation, and where it may be safe from the attacks of enemies. After a time, the skin splits down the back, and the pupa appears beneath. By means of sundry wriggles and contortions the larval skin is at last got rid of, and the pupa then lies quiescent until the time approaches for the enclosed imago to escape. During this time it is nourished by the stores of fat which it laid up while it was still a caterpillar, just as hibernating animals subsist upon their accumulated fat during their period of inactivity.

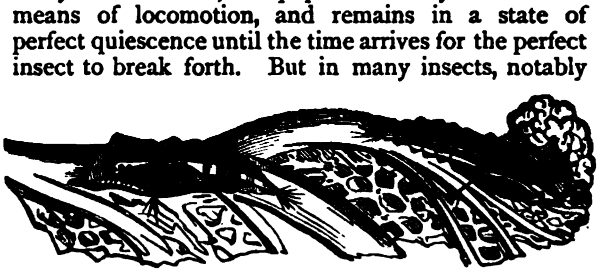


Chrysalides.

In the accompanying illustration will be seen two different stages of the transformation, the first being taken soon after the commencement of the operation, and the second when, by its struggles, the chrysalis has almost succeeded in freeing itself from its larval covering.

The larvæ of many insects bury themselves beneath the earth in order to undergo their change, generally choosing some sheltered situation, such as the roots of a tree. Some suspend themselves by the tail to a leaf or twig; others from a silken cocoon, often mingling earth, wood-chips, and similar materials with it in order to render it less conspicuous; others, again, fasten themselves to some object by means of a silken band round the body, and so on.

In the *Lepidoptera*, or butterflies and moths, and many other insects, the pupa is entirely without the means of locomotion, and remains in a state of perfect quiescence until the time arrives for the perfect insect to break forth. But in many insects, notably



Pupa of Pieris brassicæ.

the dragon-flies and others, whose earlier stages are passed beneath the water, the pupal form differs in but a slight degree from the larval, and still retains the power of locomotion, the whole habits of its life, indeed, being but little altered.

'How I teach Elementary Science.'

OBJECT LESSONS.

BY R. BALCHIN,

Head Master of the Gloucester Road Board School, London.

IN the ordinary course of school life, there are, as I stated in last month's paper, two opportunities for teaching Elementary Science, viz.:—'Object Lessons,' and the preparation of the subjects specified in the 'Fourth Schedule.' In the present condition of things, the former is a better opportunity than the latter. Hence I am devoting another article to the question of 'Object Teaching.' The reason for Elementary Science being taught better through the medium of these lessons than by taking up the 'Fourth Schedule' subjects is simply this: The latter is the subject of annual written individual examinations for grants, the former is not. Hence the superiority of the former. The School Board for London has, I believe, decided to give annual grants for success in object-lesson teaching. Good, as an encouragement. But if this grant is going to depend upon some annual written individual examination of the boys, with a view of discovering how many object-lesson facts they can put down on paper, then farewell to Science teaching altogether in most of our schools. Do Inspectors and others know what really happens to Science teaching, in expectation of their annual visits? It is this. For six or seven months in the year, some really good thoughtful lessons may be given: the boys are interested, and the subject is liked; but for four or five months before the Inspector's visit, teaching stops, and manœuvring begins: the interest of the boys flags, and the subject is disliked. Object lessons, on the other hand, not being at present degraded by any silly method of examination, the teacher need not in connection with them prostitute his powers to unworthy aims.

The scheme at present in working at Gloucester Road is somewhat as follows (we have, it should be remembered, a good museum, described in my last article, and a staff of able teachers):—

For Standard I.—The things most frequently before the eyes of the children should serve as the 'objects;' such as 'slate,' 'chalk,' the 'stone steps,' 'windows,' 'paper,' 'books,' 'ink,' 'rain,' 'dew,' 'snow,' 'wind,' and so on. A short course of lessons also on properties, illustrated by objects. It is a good plan to take for a single lesson some pair of opposite properties; such as 'hardness and softness,' 'roughness and smoothness,' 'light and heavy,' 'coarse and fine,' 'bright and dull,' and so on. Some conversational lessons on animals and plants should occasionally be given. I have found it a good plan at times to let the boys themselves suggest the subject.

As to the manner of giving these lessons, it must be borne in mind that the purposes to be served are—first, to lead the boys along lines of correct thought; second, to impart new ideas and fresh words to represent them, never forgetting that the possession of the idea should precede the definition of it.

For the First Standard, a half-hour is long enough for a lesson. What are called 'black-board notes' are an abomination. I only use the black-board for writing down the new words that are to form the addition to the boys' vocabulary, and to make rough scraps of drawings; both to be done as they occur in the lesson. Let the board be blank to begin with.

For Standard II.—Here, in addition to the subjects above mentioned, there may be given lessons leading up to the work of Standards IV. V. and VI. in the special subjects. At Gloucester Road we are taking Botany and Mechanics. Hence, simple lessons on the parts of a buttercup, a daisy, a primrose, a geranium; eatable plants, poisonous plants, etc. Never give a botany lesson unless a number of specimens can be obtained, either dried or fresh. The boys will bring them. In this Standard further properties of matter may be described, such as 'toughness and brittleness,' 'elasticity,' 'flexibility,' 'weight,' etc. Here also the three states of matter —solid, liquid, and gaseous—may be shown and explained, but avoid precise scientific definitions for the present. Be content with showing the objects that possess these properties, but never mind about scientifically defining the properties themselves. Don't, for instance, tell boys in the Second Standard, as I once heard an ambitious pupil teacher do, that 'wrought iron is tough or tenacious because the mólecules of the substance are held together strongly by the attraction of cohesion.' Simply say, 'We call wrought iron—such as this piece of a poker—tough, because it takes a great force to pull it in two; not like this roll of putty, which you see I can easily pull apart.'

For Standard III.—At this stage lessons may be given on our manufactures. These will help to make the class subject—Geography—the more attractive.

'Iron,' 'cotton,' 'gas,' 'silk,' 'leather,' etc. Always have plenty of specimens. Don't forget the museum. More advanced lessons may be given on the parts of a plant, such as 'leaves,' 'roots,' 'stems,' and 'blossoms;' different kinds of woods, 'forest trees,' and so on. Elementary ideas respecting the 'lever,' 'pulley,' 'wedge,' etc. Try to procure the models that are said to be at the Board Offices, but which, however, I have written for several times and not yet obtained. Lessons also on simple machines, such as the 'pump,' 'a pair of bellows,' or a 'lock.' I have found that good object lessons may be given on such things as a 'lead pencil,' a 'pen-knife,' a 'candle,' a 'pen,' 'limestones,' 'sandstones,' and, as far as the collection will allow, on most of the metallic and non-metallic minerals. In these latter lessons simple experiments may be performed.

In Standards IV. V. and VI., I generally make the object lessons altogether supplementary to the teaching of the special subjects. As we take two 'specials,' necessitating the giving of four lessons per week, I cannot find time for two object lessons in addition. I therefore in these Standards take one object lesson per week in the time set apart for special subjects. The lessons in this part of the school are often on Chemistry. I have just finished a course of six lessons, with experiments, on 'a piece of chalk.' And my senior assistant, Mr. Allen, is about to begin a course on the gases. He has just completed a series of lessons on Electricity and Magnetism. It is quite amusing to see the apparatus which the boys in Standards V. and VI. have themselves constructed. One boy has made a capital electrical machine out of a large pickle jar, which gives a really large spark.

Another boy has converted a medicine bottle into a good electroscope. We have dozens of Leyden jars made out of jam bottles, as well as batteries which have previously done duty as gallipots.

This article completes what I have to say on the question of object teaching. Next month I will describe the methods carried out at Gloucester Road for teaching the Science subjects of the 'Fourth Schedule.'

'A Talk about Language and Grammar.'

(*Continued from page* 132.)

BY MARTIN F. TUPPER, D.C.L., F.R.S.,
Author of 'Proverbial Philosophy,' etc.

AND now at length, having preliminarily been thus discursive about language as the verbal exponent of thought, let us address ourselves to the ranks into which words are naturally divisible, and the rules which regulate their form and order; let us have a definite talk about Grammar. The Greek word *gramma*, a writing, is obviously the origin of the term; and its English synonym—or 'same name'—is the art of writing or speaking correctly in the expression of thought. The words of any sentence in every tongue must consist mainly of these: first, there are the names, or, as the grammarian writes it, the *nouns* (*nomina*) or qualities of things, as a tree, green, beauty, beautiful. These names or, in Anglified Latin, nouns are either expressive of a whole idea—as a tree, or beauty, and are therefore called substantives capable of standing alone—or of things which only help to make up an idea when added to such substantives, as green, beautiful, etc.; and so they are called noun-adjectives, as adjected or added to their principals.

Proper nouns are merely names peculiar to persons or places, as John, Cæsar, Hampstead, Rome. After the nouns, consider, secondly, the useful little words that are handles to them, and called Articles, so called from meaning 'a little joint,' or morsel of speech helping to hold a sentence together; 'a' being called indefinite, as *a* man, which might be any man; and 'the' definite, as by *the* man indicating some particular man. In English we have only these two articles unchangeable; but in most modern languages, our own excepted, they change to show the gender or so-called sex of the noun. Greeks and Latins had three genders—male, female, neuter; the French have but two, omitting the neuter, which, strangely enough, is practically the only gender with us for ordinary nouns, though we sometimes vary this fancifully by calling a ship she and her, as if the sailors' beloved; the sun 'he,' and the moon 'she,' which our German neighbours contradict, and make the sun feminine, and the moon masculine, for some reason of ancient mythology; but in fact, nearly every language but our own is grievously encumbered with needless difficulties relating to the gender—that is, 'genus,' or breed or generation—of nouns.

To the three regular genders, masculine as 'a bull,' feminine as 'a cow,' and neuter, or neither, as 'a chair,' may be added a fourth, as 'an eagle,' he or she; this fourth class is called epicene; which ill-looking Greek word simply means common. It is manifest that in every language a feminine noun substantive must, if it have any quality added to it (that is, if accompanied by any noun adjective), cause that addition to be feminine also; such agreement being styled a concord: and though in English (which seldom alters the terminations or ends of words) the word 'fair,' for example, looks the same in letters whether applied to a man or a woman, it is clear that it would be necessarily masculine in the first instance, and feminine in the second; in Latin, the one would be 'pulcher,' the other, 'pulchra;' in French, 'beau' or 'bel' would change to 'belle.'

But let us come, secondly, to the principal *word* in every sentence, without which it cannot cohere or express anything: this is called emphatically the *verb*, from the Latin 'verbum,' a word. In any sentence, when you have taken away the nouns substantial and additional, very little is left of consequence except the verbs. There will indeed remain, thirdly, the *adverbs*, or words added to the word, as 'away,' from he ran; 'truly,' 'foolishly,' 'quickly,' etc., such adverbs in English being chiefly an adjective with the termination 'ly;' a corrupted form of 'like.' Fourthly, the part of speech called a Pronoun is a word used instead of a noun,—'pro,' for, 'nomine,' a name; as he or him for George,—instead of constant nominal repetition. A relative pronoun is one of those little substitutes for nouns which refers or *relates to* something spoken of before; as every man *who* lives; all things *which* exist, etc. A certain class of pronouns are called possessive, and are in the nature of adjectives, as *my* horse, where my is evidently masculine as agreeing with horse; *your* cows, where your must be both feminine and plural, to agree or join harmoniously with the word cows. The word plural will catch your eye or ear as requiring explanation. In English (and indeed in all languages but the learned ones, which make a special distinction in favour of two only, or the *dual*) there are only two numbers; namely one, and more than one, or many. The first is called singular, from the Latin 'singulus,' meaning one or separate; or plural, from the Latin 'plus,' meaning more than one. There are, fifthly, some few other sorts of words—or parts of speech—such as these: interjections, or little words or phrases (Greek for sentences) thrown in between; 'inter,' between, 'jacta,' thrown. Also, copulatives, joining sentences together, as and, also, beside, etc.; with which may be classed such disjunctives as or, but, etc. Then there are the prepositions, or little words placed before ('præ, posita') the nouns; and these are of special use in English as the only means of showing the *cases* or accidents to which the noun is exposed: as, The hare was shot *by* Peter *with* a gun: I am going *to* London *for* some books. The word 'parsing' a sentence, as used by grammarians, would seem to be derived from taking each individual word *per se*, by itself, and showing its nature and use in the formation of the sentence in which it may be standing; another derivation may be 'pars,' a part, or 'partim,' in parts.

As to the classes of nouns; in English and most modern languages, the names of things, or nouns substantive, are comprised in one class, and not divided into what classical grammarians call declensions or steps. But in Latin and Greek, which are tongues of a more regular construction than ours, the case is different. Let us take Latin nouns as a subject for this talk. Most people are probably ignorant of the reason why the Latins made five

classes, or declensions, of their nouns substantive—neither more nor fewer: and no book known to the writer states it; but it is always pleasant and satisfactory to discern the root, or reason, for a fact. Take, then, this idea: there are five vowels, or open vocal sounds, a, e, i, o, u. The Latins would seem to have arranged their nouns under the key-notes of these vowels, changing their order for reasons best known to themselves. As thus: A is the genius or presiding sound of the first shelf or declension, whereon the nouns are flung in bundles, every noun in it and every case or change of the noun being full of the letter a. We all recollect 'musa,' 'fama,' etc. E is the guiding letter of the fifth declension, occurring similarly in every case of those nouns. Look at 'facies,' 'spes,' etc. I governs the third class of Latin nouns, occurring in three at least of the cases both singularly and plurally; and here let us remember, that in the oldest Latin poets, as Ennius, and in the Greek nouns of this class, such terminations as 'es' were anciently written 'eis.'

(*To be continued.*)

Recent Inspection Questions.

[*The Editor respectfully solicits contributions to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add together eight hundred and six, seven hundred and twenty, fifty-four, three hundred and seventy-one, and nine. Ans. 1960.

(2) From eight hundred and ten, take ninety-three. Ans. 717.

(3) Write out the six times table.

Note.—The following words were given as an exercise in Dictation:—

sugar	**hammer**	**field**
milk	**worm**	**useful**

STANDARD II.

(1) Multiply fifty thousand eight hundred and twenty-one, by two hundred and forty-six. Ans. 12,501,966.

(2) Divide seven hundred and nine thousand five hundred and sixty-one, by six. Ans. 118,260 + 1.

(3) Divide ninety-one thousand four hundred and eight, by eight. Ans. 11,426.

STANDARD III.

(1) Divide four hundred and two thousand three hundred, by one hundred and thirty-five. Ans. 2980.

(2) Find the sum of four thousand and ninety-two pounds eighteen shillings and fivepence, and four hundred and twenty-nine pounds seventeen shillings and eightpence. Ans. £4522, 16s. 1d.

(3) Subtract forty-nine pounds sixteen shillings and twopence halfpenny, from nine thousand four hundred and two pounds eleven shillings and eightpence farthing. Ans. £9352, 15s. $5\frac{3}{4}$d.

(4) Write in figures ninety millions and eighty-one. Ans. 90,000,081.

STANDARD IV.

(1) Multiply seven hundred and sixty pounds fourteen shillings and tenpence farthing, by one hundred and sixty-eight. Ans. £127,804, 15s. 6d.

(2) Divide ninety-seven thousand four hundred and fifty-eight pounds five shillings, by one hundred and fifty-two. Ans. £641, 3s. $5\frac{1}{4}$d. + 120.

(3) Reduce one hundred and forty thousand five hundred and sixty grains to pounds (Troy). Ans. 24 lbs. 4 oz. 16 dwt. 16 grs.

(4) If the circumference of a wheel is twelve feet, how many times will it turn round in going three miles and a half? Ans. 1540.

STANDARD V.

(1) Make out in proper form and settle the following provision merchant's account:—$17\frac{1}{2}$ lbs. of cheese at 8d. per lb.; 14 lbs. of bacon at $6\frac{1}{2}$d. per lb.; 40 lbs. of butter at 1s. per lb.; 20 lbs. of butter at 8d. per lb.; and $12\frac{1}{2}$ lbs. of lard at 6d. per lb.

	£	s.	d.
Ans.	0	11	8
	0	7	7
	2	0	0
	0	13	4
	0	6	3
	£3	18	10

(2) If 15 lbs. cost £20, what will one ton cost? Ans. £2986, 13s. 4d.

(3) Find the value of 14 yds. 3 qrs. 3 nls. at 15s. 6d. per yard. Ans. £11, 11s. $6\frac{1}{4}$d. $\frac{1}{2}$.

(4) How many yards of cloth at seven shillings and sixpence a yard can be bought for a hundred pounds? Ans. $266\frac{2}{3}$ yards.

STANDARD VI.

(1) Reduce four shillings and eightpence halfpenny to the decimal of a sovereign. Ans. ·235416.

(2) Simplify $(11\frac{1}{2} - 8\frac{1}{4}) \div (3\frac{1}{3} + 2\frac{1}{4})$. Ans. $\frac{13}{23}$.

(3) How many days would 120 bushels of corn last 18 horses, if 20 bushels last 12 horses 10 days? Ans. 40 days.

(4) Divide the product of 16·004 and ·004 by 2·08. Ans. ·030776 +.

Domestic Economy.

(1) How would you clean a floor?

(2) How would you clean furniture and fire-irons?

(3) State the best mode of warming and ventilating a house.

(4) Which is the best washing day? What preparations would you make for it?

(5) How should flannel be washed?

Grammar.

STANDARDS IV. AND V.

Parse and analyse, 'The birds flew away to warmer lands in winter.'

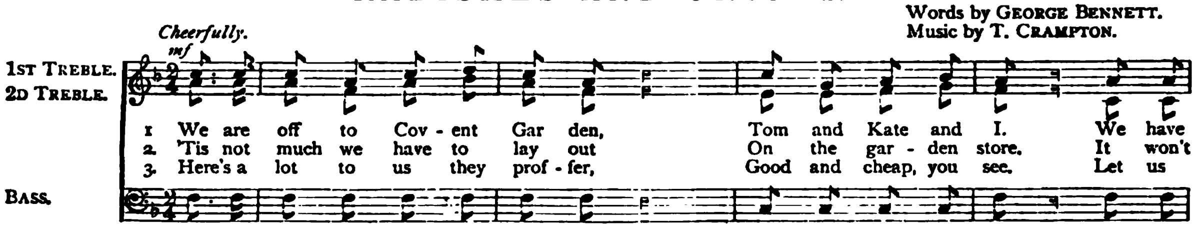
STANDARD VI.

(1) Parse and analyse, 'When their supply of food fails them, they seek warmer climates.'

(2) Write a letter to a friend telling him how you spent last Saturday.

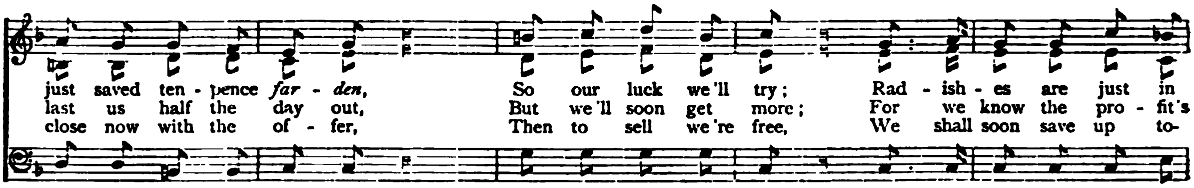
RADISHES AND ONIONS.

Words by GEORGE BENNETT.
Music by T. CRAMPTON.



KEY F. *Cheerfully.* *mf* C. t.

1ST TREBLE.	:s .,s	s .m :s .l	s .m :	s .r :m .f	m . :ᵐl .l
2D TREBLE.	:m .,m	m .d :m .f	m .d :	t_1 .t_1 :d .r	d . :ˢd .d
BASS.	:d .,d	d .d :d .d	d .d :	s_1 .s_1 :s_1 .s_1	d . :ᵈf .f

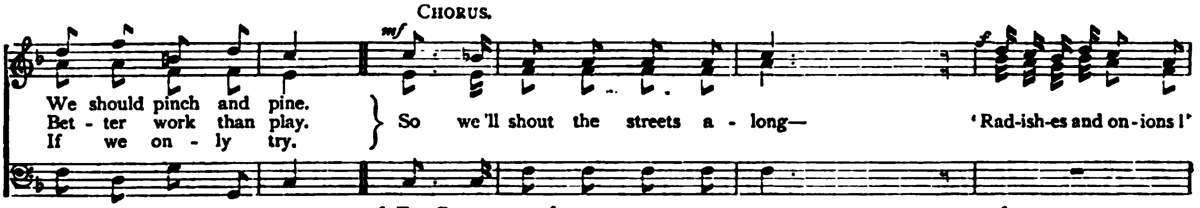


f. F.

l .s :s .f	m .s :	t .d' :r' .t	d' . :ˢr .,m	r .r :s .f
t_1 .t_1 :r .r	d .m :	r .m :f .r	m . :ᵐt_1 .,d	t_1 .t_1 :t_1 .s_1
r .r :t_1 .t_1	d .d :	s .s :s .s	d . :ᵈs_1 .,s_1	s_1 .s_1 :s_1 .t_1

C. t.

m .d :	m .l :se .t	l :ˡr' .r'	r' .s :s .s	s .d' :
s_1 .s_1 :	d .d :t_1 .r	d :ᵈf .f	f .f :f .f	m .m :
d .m :	d .l_1 :m .m_1	l_1 :ˡ¹r .d	t_1 .t_1 :t_1 .t_1	d .d :



f. F. CHORUS. *mf* *f*

r' .f' :t .r'	d'	:ᵈ's .,f	m .m :m .m	s :- .	l,s .f,l :s .m
l .l :f .f	m	:ᵐt_1 .,t_1	d .d :d .d	m :- .	f,m .r,f :m .d
f .r :s .s_1	d	:ᵈs_1 .,s_1	d .d :d .d	d :- .	:

:	s .d' :s .f	m .r :d	l .s :r,m .f,s	m .d
:	m .m :r .s_1	s_1 f_1 :m_1	d .d :t_1,d .r,t_1	d .m_1
ff s_1,s_1 .s_1,s_1 :s_1 . d	d .d :t_1 .t_1	d .s_1 :l_1	f_1 .m_1 :s_1,s_1 .s_1,s_1	d .d

The Practical Teacher.

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John Richard Langler, B.A., F.R.G.S.,

THE PRESIDENT OF THE NATIONAL UNION OF ELEMENTARY TEACHERS FOR 1881.

A NECESSARY effect of the arrangements and organization of the N.U.E.T. has been to bring into prominence, year by year, teachers distinguished among their fellows for their personal worth and general ability. These qualities, when combined with energetic action, give influence in any sphere which affords opportunity for their exercise. Illustrations of this general principle are especially noticeable in the inception and working out of new schemes involving widespread interests, affecting, variously, different and diverse classes and conditions of society, and necessitating complicated details of organization and effort. *Many*, as was meet, contributed, each one according to his several ability, much or little, to the common store of fact, and thought, and opinion which set forth the necessity, and gradually showed the practicability, of this great association of teachers. A *few* only, as was inevitable, brought the comprehensiveness of view, the practical sagacity, the prudence, the tact, and the patient vigorous labour, so to bear upon the gathered materials as out of them to construct the Union and to carry it on to its present development.

No wise man would expect any human scheme to reach the twelfth year of its existence absolutely free from fault, or from error in its progress; but the Elementary Day-school Teachers of England may be congratulated on the position and status occupied by their National Union to-day, and may well be thankful if twelve years hence it shall have made a corresponding advance in number and in influence, and be found equally well adapted to the altered conditions which National Education will then have assumed. For the result thus far achieved, the Union is largely indebted to the skilful and self-denying efforts of the small company of teachers who, in 1870, first established the Union, and to their co-workers and successors who have secured its present issue. They were fortunate in the admirable selection, made by the Union, of their first paid secretary, whose singleness of purpose, sagacity, and ability are so universally and deservedly recognised. And the successive Presidents have, on the whole, done honour to their choice. The responsibility attaching to this office is not inconsiderable. During the sitting of Conference, public attention is, year by year, increasingly directed to the words and acts of its chief officer; during the year of his presidency, his influence largely sways the decisions and deeds of the executive; in interviews with officers of the Education Department, or Members of Parliament; as representative of the Union at meetings of other educational bodies; and in various other ways, much depends for good or harm, to the interests of teachers, and the higher and more important interests of National Education, on the wisdom and the personal character of the President.

For these reasons the President should ever be, not only one whom his fellows delight to honour by the office, but whose qualifications shall enable him to bring honour to the office. In the President for 1881, these requirements seem to be combined in a pre-eminent degree. Mr. John R. Langler, B.A., F.R.G.S., is a practical teacher of proved ability and of very varied acquirements. His teaching experience, in what is sometimes denominated the Primary Education of the country, touches the two extremes of the management and instruction of infant schools on the one hand, and the work of tutor in the advanced classes of a Training College on the other, ranging also through various grades and degrees of classes between these extremes. He is also practically acquainted with the methods and requirements of Secondary Education, having been for some time junior assistant in Sion House Academy, Jersey, in which admirably-conducted and well-known school he had been previously a pupil.

Mr. Langler thus possesses that essential qualification to a just and comprehensive view of the work of teaching, and the life of a teacher, which can be acquired in no other way than by actual participation in several departments and conditions of both. His preparation for the work, which has occupied the greater part of his life, was varied and ample. Born in Devonshire at Brixham-on-Torbay, in 1826, he was very early sent to school at Dartmouth, under the care of the Rev. J. Greaves, M.A. At eleven years of age he was entered as pupil at Sion House Academy, Jersey, as already mentioned. The Principal was Mr. E. Neel, and the late Dr. Kessen was senior tutor. An incidental advantage of his residence here was the acquirement of an accurate knowledge of the French language, which he learned to speak with great facility. While assistant-master in this institution, Mr. Langler was offered the charge of a school at Gaspé in North America, where French was generally spoken; but having then a desire to enter on missionary work, he declined the invitation.

At this time the Wesleyan Education Committee had entered upon the work of establishing day schools in connection with their community in various parts of England. An essential part of the system was the preparation and training of teachers. As, after due inquiry and consideration, they had decided upon the adoption of the 'Training System' of education as developed by Mr. David Stow of Glasgow, the young persons selected as teachers were sent for training to

the Normal College established in that city by Mr. Stow. In 1844 Mr. Langler offered himself for this work, was accepted, and duly entered the institution.

At that time the Glasgow Training College was in the zenith of its fame. Mr. Stow, in the prime of his energy, diffusing among the students his own enthusiastic love of teaching; Mr. Hislop, the rector, vigorous, accomplished, of rare personal influence; Mr. Fraser (afterwards LL.D.), an able, earnest, and graceful teacher; Mr. David Caughie, *facile princeps* of infant teachers; and Mr. W. Sugden, B.A., for more than thirty years the highly-esteemed head master of the Westminster Training College—all of whom have now passed from amongst us—were then earnestly and happily engaged in the training of the students. The formative influences of such a place and time were great, and Mr. Langler yielded himself up to them with sympathetic ardour. He became thoroughly versed in the principles and methods characteristic of the Glasgow Training System, and developed especial skill in their application. This led to his appointment as master of the infants' department of the Rusholme Road School, Manchester, in 1845; and in 1850, to the charge of the same department of the practising schools of the Westminster Training College. These schools were designed on the model of those at the Glasgow Normal Seminary.

Here his work was most congenial. His ardent desire was to have the best infants' school in the country; and his loving sympathy for the little ones, the respect he won from their parents, his unflagging zeal, and daily conscientious preparation, coupled with the lofty conception he had formed of the true nobility of the teacher's work, certainly contributed in no small degree to the attainment of that end.

From a Photograph by the London Stereoscopic Company.

For a short time he was the master of the Model School. Much of his time was devoted to the instruction of the students, male and female, who first became resident at Westminster, in 1851. He took special charge of the classes in School Management for the infants' and girls' schools, and gave instruction in Arithmetic, Geography, and French. In 1856 he obtained, on his first examination, a Lectureship in Geography, of the value of £100 per annum (as proposed by the Rev. Canon Moseley), and held it until the advent of Mr. Lowe's famous Code of 1861, which took away all personal payments. On obtaining the Lectureship he became a Fellow of the Royal Geographical Society, and shortly after, he graduated B.A. at the London University.

At a date long prior to this, however, viz. in 1848, Mr. Langler had obtained a Government Certificate, having sat for this purpose at the first examination accessible to Nonconformists, under the Minutes of Committee of the Privy Council for Education, issued in 1846. His name appeared second on the list of successful candidates, Mr. Crampton, of musical fame, being the first.

As the work of the College became fully developed, Mr. Langler was relieved from service in the schools, and his time was devoted entirely to the work of tutor to the students. His varied acquirements, genial disposition, and enthusiasm in teaching, made him a great and general favourite with his pupils.

For a quarter of a century he proved himself a 'faithful servant.' Of the spirit in which that work was done, and of the value set upon it by those whose high privilege it was to be influenced by it, we can, perhaps, give no better idea than by culling the following extract from the address which, with several valuable presents, was given to Mr. Langler in 1875 by the students then in residence, upon his accepting the office of lay secretary to the Wesleyan Education Committee: 'We desire to express the esteem and affection which we have for you, and the high regard which we have ever entertained for your character and work. We are deeply sensible of the great kindness and affability which always characterized your dealings with us, and grateful for the lively interest which you ever took in our welfare. We shall always cherish the memory of our connection with you as one of the brightest recollections of our college life.'

Mr. Langler is the author of the following excellent and widely-circulated school publications: *The Pictorial Geography for Young Beginners*, *The Popular Astronomy*, and *Mathematical Geography*, a series of *Reading Sheets*, *Primer and First Reading Book*, *Spelling Books*, and *Table Cards*. He has also issued, in conjunction with Mr. Joseph Hughes, a series of *Standard Geographies*, though the greater part of this work, we understand, fell upon Mr. Langler's shoulders. For the compilation of all these, his exact know-

ledge and long experience have especially qualified him.

On the decease of the late William Hughes, Esq., the well-known geographer, Mr. Langler was appointed in his place as Examiner in Geography to the College of Preceptors. He is the departmental secretary for Training Colleges, and thus *ex officio* a member of the Council of the Education Society. He succeeded Mr. Thomas Smith as chairman of the Board of Directors of the Educational Newspaper Company.

Mr. Langler has been a member of the Executive of the National Union of Elementary Teachers since its formation in 1870. In this capacity he has rendered invaluable service to the profession. His work has been done quietly and effectively. He has been vice-chairman of the Benevolent Fund since its origin, and vice-chairman of the National Provident Society, and is one of the trustees of each of these funds. He is also a member of the Council of the Orphanage and Orphan Fund.

The honour conferred upon Mr. Langler by his appointment as President of the Union is well deserved. While resident in Manchester more than thirty years ago, he was a valued member of the Manchester and Salford Teachers' Association. He has ever shown himself anxious to advance the best interests of teachers, devoting time and energy unsparingly to promote this object. We believe the welfare of the Union is safe in his hands, if professional ability, knowledge of educational processes and needs, high moral worth, and prudent zeal in its service, can make it so. And we heartily wish for the National Union of Elementary Teachers, and its President, a year of peace and prosperity.

The Late William Sugden, B.A.,

Head Master of the Wesleyan Training College, Westminster.

MANY thousands of our readers in this and other lands will regret to hear of the death of Mr. Sugden, who for above thirty years was the head master of the Training College at Westminster. We have a mournful pleasure in reproducing Dr. Rigg's address, delivered at Battersea on the 10th May, the day of the funeral. He said :—

My dear Friends,—We sorrow not as those who have no hope. This is a mournful, yet it is a triumphant occasion; there is a mist of sorrow that dims the scene and the prospect, but there is much more than a glimmer of glory that comes through; there is a celestial morning that is breaking through the mist, there is the hope and the assurance of a blest eternity. It is not my duty this morning to deliver a memorial eulogy, or to make any attempt at funeral eloquence. There is no eloquence which can compare with that of this scene as I look around me, nothing which could so touch, nothing which could so deeply move, nothing that could so blessedly inspire as these relics before us, that tell of a noble history, that prophesy a blissful eternity—a completed felicity for the body, soul, and spirit of our friend departed. But it is my duty to say that we are gathered here this morning to mourn with a Christian mourning, and to rejoice with a Christian hope over the history of one who was no common man. Mr. Sugden was no common man; he held, in relation to the great work of Christian education in connection with our Church, a unique position. His memory is enshrined in very many hearts and souls—not only here, where he lived; not only at Westminster, where he laboured so long and faithfully; not only in England and in Scotland, where he was never forgotten, having once had there his place of abode and his sphere of influence, but throughout the whole world Mr. Sugden's memory lives—nay, it may not be known there yet that he has gone —but his memory, as that of Mr. Sugden who was known at Westminster, lives and is fragrant in every continent. I have met with those in America who have spoken to me of him; in South Africa there are distinguished teachers, Christian instructors, who were trained under him; in Australia there are several of that class, and there is one there especially—the head of the Prince Alfred College, Adelaide, who takes scarcely less than the foremost place amongst the teachers of that hemisphere—who was one of the favourite students under the care of Mr. Sugden; and in the isles of the sea and those wonderful mission regions there are teachers who have gone out to work amongst the natives after they had been trained under William Sugden's influence. I say, then, it is no common man whose decease has brought us together to-day. For wideness of influence, for pure unmingled beneficence of influence, there are few in our denomination who can compare with him. He was the son of a faithful, hard-working Methodist minister, a native of the mountainous region of the West Riding, and he was the brother of another Methodist preacher who is greatly beloved and esteemed. He was born in the year 1819, and went, I think in 1828, to the Woodhouse Grove School, where he was the friend of Mr. Frankland and Mr. Gregory and others I might name, and where he was well grounded by that famous master, Mr. Parker, especially in Latin and the science of numbers. When he was fourteen years of age he went to Leeds to learn the business of a civil engineer, and there, in the practical workshops belonging to the great engineering works of the Fairbairns, he obtained a mastery of mechanical knowledge; and there, also, he became grounded in the Christian faith. Many of his companions in these workshops were unbelievers, not a few of them disbelievers in anything like faith, either Christian or other; and amongst them, day by day, and year after year, he maintained his integrity as a believer in Christ Jesus and as a Methodist. Doubtless that intercourse somewhat tried the temper and quality of his spiritual understanding at times, and he found it difficult to hold his own; but the result was a breadth and strength and depth of religious faith and conviction such as comparatively few men have possessed. I believe it was the late George Browne Macdonald, one of our eminent ministers stationed at Leeds in 1842, who found William Sugden there, a young engineer, a member of society, and a local preacher, and he thought he would find a fitter field if he were transferred to the Education Department. The consequence was, that in 1842 or 1843 Mr. Sugden went to Glasgow, under the direction of the Methodist Education Committee, that he might there be trained for educational work. He was afterwards appointed to a school at Holmfirth, in Yorkshire. About the year 1843 the education movement in the Wesleyan denomination—under the chief direction of the Rev. John Scott—commenced; and in consequence of that, Mr. Sugden was sent from Holmfirth to Glasgow as the agent of the Committee, in order to take a kind of charge and guardianship of the students sent there. Mr. David Stowe, the great educationist, found in Mr. Sugden a congenial spirit, and made a place for him in his own practising schools attached to the Free Church Normal Seminary at Glasgow. In 1850 Mr. Sugden left Glasgow for Westminster, where he entered upon the task of organizing the practising schools. He returned to Glasgow for a few months to complete his studies for the University and take his degree; he returned to Westminster at Midsummer 1851, and remained there to the end, a period of nearly thirty years. For many years John Scott, as principal, and William Sugden, as head master, worked together—two nobly-mated men; and it is not too much to say that a great deal of the high character and bearing of the College and those who have been trained in it has been due to the character and influence of Mr. Sugden. He was a man of a very well furnished mind: there were very few departments of study that he had not made his own; he was a sound, sober, accurate thinker—a stedfast, hard student all his days; and doubtless that stedfastness of hard study till late at night, continued to the very end, shortened his days. But what an amount of work has been put into that life of sixty-one years! Mr. Sugden's influence always struck me as being something remarkable: he reminded me of a giant, almost in his bodily appearance; and his strength seemed to be much above the ordinary standard, but his gentleness was that of a woman, and his simplicity that of a child. One striking feature of his character was the quiet supremacy with him of duty. Of ambition he seemed to have none, unless that can be called ambition, to do all that belongs to a

man's duty in life as well as it is possible to do it, and equally whether in sight of others or not—in that respect he was like the great commander Wellington: duty was the one law that seemed continually to regulate and animate his life. He was not in any respect a demonstrative man, or one to talk much about religion, except sometimes in perfect privacy; but he was a man whose whole life had the light of religion always on its fringes, so that people saw and felt that the life of religion was throughout a part of its very web, of its very texture. In teaching at the College, his accuracy, his fulness of knowledge, and his keen and living interest with regard to Scripture, struck the students with whom he had to do. I have said that he was an assiduous worker in the pathway of duty. He was a devoted toiler for our College. He left College and came home, not to recreate, but to go into his room with his papers, and to inform himself on every subject which in his position he might be called upon to understand. There were very few works on physical science with which he was not well acquainted. There were few master works, indeed, in any great department of information which he had not carefully read. Such work, however, so long continued, could not but tell on his constitutional strength. For some time, those who were associated with him had noticed that he was gradually failing in strength: his eyes had become peculiarly affected, and his speaking was not as clear as it had been; in fact, there were infirmities coming upon him: others could not but see it, and he himself knew it quite well. It could not be said that death at an early age surprised him: he never expected long life; his father died at the age of sixty-one, as the result of a sudden stroke, others of the family had died about the same age, and he has said to me many times that he could not expect to live to be much more than sixty years of age. Therefore, when there came that touch which disabled him last Christmas, he took it as a token that his years were coming to a close. Those who were present on the Friday before the Valedictory Address was delivered would never forget the spirit and love of Mr. Sugden's words on that occasion, nor his wan and pale look as he uttered them. He spoke with a little more effusion than was usual with him, almost as though he felt that he might not have another such opportunity of addressing an assembly of students about to leave the College. On the following Monday night he became unconscious in his room at home, and that was the beginning of the end. Some weeks afterwards he went to the Isle of Wight, and returned somewhat better not yet a fortnight ago. Last Tuesday he came to the College, having set his mind on doing a little work again. I took upon myself to say he should not take the reading; but I consented that he might try the Latin. He went into the College, said a few words to some of the students, and then went home, as he said, to prepare for the morrow. On the following day he went out into the park with Mrs. Sugden, was seized with palpitation, and walked slowly home. The heart had done its work; no artificial means could give back the vital warmth or force; he moved between the bed and the easy-chair, and as he reached the easy-chair for the last time, he threw back his head, and died between eight and nine the next morning (last Thursday). William Sugden was one of those characters with the remembrance of whom there is associated no single thought of darkness; his was a godly, consecrated life of unostentatious service as always in the sight of the Great Taskmaster. I have never heard of anybody who complained of any word of his that has rankled or left any bitterness or sting behind. Those who belonged to him may thank God in this hour of his removal and be filled with consolation. I may be permitted here to mention what was said to me by her who was—and is—nearest and dearest to him, that in the thirty years of their married life she had not only never known him say a harsh or a sharp word, but not even an inconsiderate word. Let us glorify God in him, and thank God we have had the services of such a man. At Westminster, in particular, he has been like a sheet-anchor all these years, and the traditions of his character and influence will live there from generation to generation. We have here the family that mourns, but I doubt not before long the God of consolation will have turned this sharp deep wound into a well-spring of purest comfort, holiest memories—a blessing to them, and all belonging to them, from generation to generation. My dear friends, death's shafts fly thick; how many of our friends, of my best and dearest friends, have gone, those about my own age, during the past eight or ten years! What is the lesson to us? That we must learn to look upon death without too much of sadness. We must learn to regard it as a transition, a translation; we must believe in the communion of saints, not only as respects this life, but as respects the life to come. Eternity must be a more real world to us than it has ever been. If that be the result of these frequent bereavements, these heartrendings, they will be blessed indeed, and we shall not only be able to look forward to our own change with perfect tranquillity, but be able to understand better the blessed meaning of the grand Christian glow of hope and joy and triumph which breathes in the inimitable hymns which it is our privilege to sing on these occasions; we shall learn to

'Rejoice, for a brother deceased.'

May we all learn this lesson! May God comfort the widow, guide and bless the fatherless; and may every one of us do our duty simply and humbly, as William Sugden did; and may we be, like him, ready for God's will at any moment through Jesus Christ our Lord!

Publications Received.

Arithmetic—

(1) Marshall's Arithmetic. Parts I., II., III. Marcus Ward & Co.

Athletics—

(1) Spencer's Bicycle Road Book. Griffith & Farran.

English History—

(1) Powell's Historical Reader. Longmans & Co.
(2) Gardiner's Outlines of History. Longmans & Co.

English Literature—

(1) Byron's Siege of Corinth. Chambers.
(2) Wordsworth's Ode to Duty. Chambers.
(3) Shakespere's Midsummer Night's Dream. London: Rivingtons.

Ethics and Morals—

(1) Hime's Morality. Guest.

Euclid—

(1) Cassey's Sequel to Euclid. Longmans & Co.

Fiction—

(1) Modern Wonders of the World. Strahan & Co.

Geography—

(1) Lupton's Geography. Longmans & Co.
(2) Ward's Child's Geography. Marcus Ward & Co.
(3) Universal Atlas. Marcus Ward & Co.
(4) Geographical Reader. Book III. E. Stanford.

Grammar—

(1) Daniel's English Grammar. Part I., price 3s. Part II., price 2s. 6d. Complete price, 5s.

Mechanics—

(1) Hewitt's Class-Book of Elementary Mechanics. Philip & Son.
(2) Browne's Mechanics for Junior Students. J. Heywood.

Music—

(1) Pearson's Notation of Vocal Music. Reeves.

Mythology—

(1) Bianchi's Mythology of Greece and Rome. Marcus Ward & Co.

Periodical Literature—

(1) Ward & Lock's Universal Instructor. Ward & Lock.

Science—

(1) Dunman's Starlit Sky. Griffith & Farran.
(2) Dunman's Pre-Historic Man. Griffith & Farran.

The Scriptures—

(1) New Testament, Revised Version London: Oxford and Cambridge Warehouses.

Writing—

(1) Marcus Ward's Improved Writing Copy-Book. Marcus Ward & Co.

Pupil Teacher's Examination Questions.

APRIL 1881.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the cost of 199 yds. 2 ft. 4 in. at £1, 3s. 5¼d. a yard.
2. How much will be left of £400, after an account for 303,296 ozs. at £43, 11s. 8d. a ton has been paid out of it?
3. The expense of keeping 6 horses for 7 months amounted to £118, 4s. 3d. Two of the horses were then sold; how long were the remaining horses kept for £123, 16s. 10d.?
4. If 6 men or 15 boys can do a piece of work in 18 days, in how many days will 4 men and 10 boys together do it?

FEMALES.

1. Make out the following bill:—

		s.	d.	
49½ stones of flour	at	2	8	per stone.
76½ lbs.	,, cheese ,,	0	8	per lb.
101¼ ,,	,, butter ,,	1	7	,,
20¼ ,,	,, tea ,,	3	4	,,
38½ ,,	,, coffee ,,	1	5	,,
177¾ ,,	,, pork ,,	0	9	,,

2. Find the cost of 48 cwt. 3 qrs. 3 lbs. at £1, 17s. 6d. per cwt.
3. 265408 at £10, 14s. 7½d. each.
4. Find, by Practice, the worth of 24510 rupees at 1s. 11⅝d. each.

Grammar.

1. Point out and parse all the adverbs and adjectives in the following:—

'There is no breeze upon the fern,
No ripple on the lake,
The small birds will not sing aloud,
The springing trout lies still,
So darkly glooms yon hidden cloud,
That swathes, as with a purple shroud,
Benledi's distant hill.'

2. Show how verbs may be classified according to inflexion, that is, according to their mode of forming their past tense, and give one or two examples in each class.
3. Give the possessive case of the following nouns:—Child, children, prince, princess, John, James.

Geography.

1. What is the nearest seaport to your home? Trace, in words, a coasting voyage from it, either to London, Liverpool, *or* Bristol, choosing whichever is the most distant.
2. Describe minutely the basin of the Yorkshire Ouse. *If you can*, draw a map in illustration.
3. Say what you know about the Scotch and Irish lakes.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

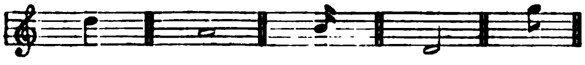
Write, in large hand, as a specimen of copy-setting, the word *Burglary*.

Write, in small hand, as a specimen of copy-setting, '*Now, Warwick, tell me, is Edward your true king?*'

Music.

A quarter of an hour allowed for this paper.

1. Write over each of the following notes its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other):—



2. Follow each of these notes by its corresponding rest:—

3. How many tones and semitones are found in a major scale, and what are the places of the latter?

ANSWERS—CANDIDATES.

Arithmetic.

MALES.

1.

	£	s.	d.	
	1	3	5¼ × 9	
			10	
	11	14	4½ × 9	
			10	
	117	3	9	
	105	9	4½	
	10	10	11¼	
	233	4	0¾	= value of 199 yds.
1 ft. 6 in. = ½ yd.		11	8⅝	= ,, 1 ft. 6 in.
9 ,, = ½ of 18 in.		5	$10\frac{5}{16}$	= ,, 9 in.
1 ,, = ⅑ of 9 in.			$7\frac{13}{16}$	= ,, 1 in.
	£234	2	3½	= value of 199 yds. 2 ft. 4 in.

2.

16 { 4)303296 oz.
4)75824

28 { 7)18956 lbs.
4)2708

4)677 qrs.

20)169 cwt. 1 qr.

8 tons 9 cwt. 1 qr. at £43, 11s. 8d.

	£	s.	d.	
	43	11	8	
			8	
	348	13	4	= value of 8 tons.
5 cwt. = ¼ ton	10	17	11	= ,, 5 cwt.
4 cwt. = ⅕ ,,	8	14	4	= ,, 4 ,,
1 qr. = $\frac{1}{16}$ of 4 cwt.		10	10¾	= ,, 1 qr.
	£368	16	5¾	= value of 8 tons 9 cwt. 1 qr.
	400	0	0	

∴ remainder = £31 3 6¼ Ans.

3.

4 horses : 6 horses :: 7 mos.

£	s.	d.		£	s.	d.
118	4	3	:	123	16	10
20				20		
2364				2476		
12				12		
28371				29722		

$$\frac{7 \text{ mos.} \times \overset{14861}{\cancel{29722}} \times \overset{3}{\cancel{6}}}{\underset{4053}{\cancel{28371}} \times \underset{2}{\cancel{4}}} = \frac{44583}{4053} = 11 \text{ mos.}$$

4.

6 men can do 15 boys' work.
1 man ,, 2½ ,,
∴ 4 men ,, 10 ,,

So the question now reads:—'If 6 men, etc. . . . in how many days will 8 men do it?'

8 men : 6 men :: 18 days : 13½ days. Ans.

FEMALES.

			s.	d.			£	s.	d.
1.	49½	stones at	2	8	per stone	=	6	12	0
	76½	lbs. ,,	0	8	per lb.	=	2	11	0
	101¼	,, ,,	1	7	,,	=	8	0	3¾
	20¼	,, ,,	3	4	,,	=	3	7	6
	38½	,, ,,	1	5	,,	=	2	14	6½
	177¾	,, ,,	0	9	,,	=	6	13	3¾
							£29	18	8 Ans.

2.

	£	s.	d.	
	1	17	6	
			6	
	11	5	0	
			8	
	90	0	0	= value of 48 cwt.
2 qrs. = $\frac{1}{2}$ cwt.		18	9	= ,, 2 qrs.
1 qr. = $\frac{1}{2}$ of 2 qrs.		9	$4\frac{1}{2}$	= ,, 1 qr.
2 lbs. = $\frac{1}{14}$ of 1 qr.			$8\frac{1}{28}$	= ,, 2 lbs.
1 lb. = $\frac{1}{2}$ of 2 lbs.			$4\frac{1}{56}$	= ,, 1 lb.
	£91	9	$1\frac{31}{56}$	= value of 48 cwt. 3 qrs. 3 lbs.

3.

	£	s.	d.	
	265408	0	0	
			10	
	2654080	0	0	= value of 265408 at £10.
10s. = $\frac{1}{2}$ of £1	132704	0	0	= ,, 10s.
4s. = $\frac{1}{5}$ of £1	53081	12	0	= ,, 4s.
6d. = $\frac{1}{8}$ of 4s.	6635	4	0	= ,, 6d.
$1\frac{1}{2}$d. = $\frac{1}{4}$ of 6d.	1658	16	0	= ,, $1\frac{1}{2}$d.
	£2848159	12	0	= value of 265408 at £10, 14s. $1\frac{1}{2}$d.

4.

	£	s.	d.	
	24510	0	0	
2s. = $\frac{1}{10}$ of £1	2451	0	0	= value of 24510 at 2s.
(Subtract) $\frac{1}{2}$d. = $\frac{1}{48}$ of 2s.	51	1	3	= ,, $\frac{1}{2}$d.
	£2399	18	9	= value of 24510 at 1s. $11\frac{1}{2}$d.

Grammar.

1. ADVERBS AND ADJECTIVES.

no—adj. of quantity qual. *breeze*.
no—adj. of quantity qual. *ripple*.
small—adj. of quality qual. *birds*.
not—adv. of negation modifying *will sing*.
aloud—adv. of manner modifying *will sing*.
springing—adj. verbal, qual. *trout*.
still—adv. of manner modifying *lies*.
so—adv. of degree modifying *darkly*.
darkly—adv. of manner modifying *glooms*.
yon—adj. of distinction pointing out *cloud*.
hidden—adj. verbal, qual. *cloud*.
purple—adj. of quality qual. *shroud*.
distant—adj. of distinction pointing out *hill*.

2. Verbs are divided into two great classes from the manner of forming their past tense.

(1) Verbs which form the *past tense* by a change in the body of the word; as, *give, gave; shine, shone; wring, wrung.* These are called *strong*, and sometimes *irregular* verbs.

(2) Verbs which form the *past tense* by adding *d* (*ed*) or *t* to the *present*; as, *turn, turned; leap, leapt.* These are called *weak*, and sometimes *regular* verbs.

3. POSSESSIVE CASE.

Child's.	Princess's.
Children's.	John's.
Prince's.	James's.

Geography.

1. Starting from *Portsmouth* (as our nearest seaport) we may remark that it is the first naval station in England. Sailing through *Spithead*—the famous roadstead—we pass *Southampton*, a great packet station, skirt the coast of the *Isle of Wight*, which has been called the garden of England, navigate the channel called the *Solent*, and observe the *Needles*, the termination of the Isle of Wight. The coast now curves round to *Poole Harbour*, south of which is the *Isle of Purbeck* with its limestone known as Purbeck marble. After passing *St. Alban's Head* we reach *Portland Bill*, with excellent building stone, and as we describe the curve round to *Start Point*, we meet with *Lyme Regis, Torbay, Torquay, Dartmouth*, and reach *Plymouth*, noted for its gigantic breakwater, with *Eddystone Lighthouse* to the south. As we continue towards *Lizard Point* we note *Falmouth*, a packet station, and *Mount Bay*, so named from *St. Michael's Mount* situated in it. *Penzance*, noted for its mild climate, lies near *Land's End*. Proceeding north-east, we round *Hartland Point* into *Bideford Bay*, with *Lundy Isle* on our left. Continuing easterly we reach *Bristol*, the fourth seaport of England; then coasting the north side of the *Bristol Channel*, we arrive at *Cardiff*, the chief mineral port of South Wales, and westwards we visit *Swansea* on Swansea Bay, *Caermarthen Bay*, and *Pembroke* on Milford Haven, one of the finest harbours in Britain. Passing St. Bride's Bay and round St. David's Head, we coast the curving line of *Cardigan Bay*, with *Cardigan, Aberystwith, Barmouth*, and *Harlech*. Doubling the peculiar peninsula of *Caernarvon* we come to *Caernarvon Bay*, and enter *Menai Straits*, which divides the *Isle of Anglesea* from the mainland. We cannot but note the suspension and tubular bridges which span the strait. *Bangor*, near the bridges, has beautiful scenery; and farther south is *Caernarvon*, with the castle in which the first Prince of Wales was born. Rounding *Great Orme's Head* we pass the *Mouth of the Dee*, on which stands *Chester*, a very interesting town, and enter the *Mersey*, on which stands *Liverpool*, perhaps the first port in the world. Opposite this city is *Birkenhead*, with magnificent docks.

2. The *Ouse* and its branches water the plain which lies between the Yorkshire Moors and the Pennine Range. Among the moorlands of the Pennines rise two rivers, the *Swale* and the *Ure*, eventually uniting to form the Ouse, which continues in a south-easterly direction, and receives the *Nidd*, one of three rivers coming from the same region as the parent streams. The other two are the *Wharfe* and the *Aire*. Thus five rivers flow into the Ouse on the right bank, and these rise in the same district of the Pennine Range. On the left bank the river receives only one stream, the *Derwent*, rising in the Yorkshire Moors. The seventh tributary of the Ouse is the *Don*, which, coming from its source in the southern extremity of the Pennine Chain, flows in a north-easterly course to join the Ouse nearly at the junctions of the Aire and the Derwent.

3. The lakes of Scotland, for the most part, are gathered into its *western* half, where, cooped in by long narrow glens, they take almost the form of rivers, being generally many miles in length and scarcely one in breadth. In the northern Highlands north-west of Glenmore, which is itself occupied by a chain of lochs, the lakes are ranged in almost parallel lines from Loch Shin southwards. But the most beautiful of the Scottish lakes lie in the west of the shires of Inverness, Argyle, and Perth, where among the group of the Grampian Peaks the lakes are ranged similarly to the Cumbrian system of England, namely radiating outward like the spokes of a wheel.

The greater number of the Irish lakes extend over that half of the island which lies north-west of a line drawn from Belfast Lough to Kenmare river. In this respect Ireland resembles the Highlands of Scotland; but the Irish lakes differ very much from those of Scotland in their distribution and relation to each other, for instead of radiating from a centre, they form long chains of water joined to one another by connecting rivers.

Music.

3. Five tones and two semitones, the latter being found between the third and fourth, and seventh and eighth notes.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the value of $\frac{(1+\frac{1}{2}+\frac{2}{3}+\frac{3}{4})\times(\frac{4}{15}-\frac{3}{10})}{2\times10\frac{5}{8}}$ of £1·6.

2. £$4\frac{11}{16}$ is charged for 3·6 yards of velvet,—how much should I have left of £50 after paying for 32·88 yards of the same sort?

3. I receive 2·1 guineas and £·416, and pay from this amount 18·75 half-crowns and $\cdot 3\dot{5}7142\dot{8}$ of a guinea. What vulgar fraction of a £ have I still in hand?

4. A grocer, who had bought a small chest of tea, kept $\frac{3}{5}$ of ·94 of it for himself, and sold the remainder = 26·25 lbs. What was the original weight of tea in the chest?

FEMALES.

1. A person owes £1537, 3s. 4d., but can pay only £960, 14s. 7d.; what will be the dividend, and how much shall I receive for a debt of £276, 11s. 6d.?

2. A field of 16 acres produces 440 bushels of wheat; how much is that upon every 22 sq. yds.?

3. If 5 men can reap a field whose length is 800 ft. and breadth 700 in $3\frac{1}{2}$ days of 14 hours each, in how many days of 12 hours each can 7 men reap a field whose length is 1800 ft. and breadth 960?

4. If 15 men eat 13 shillings worth of bread in 7 days, when wheat is 12 shillings a bushel, what should be the price so that 10 men should be furnished for $12\frac{1}{4}$ days at the same cost?

Grammar.

1. 'Habits early engrafted on children—of regular attention, of steady application to what they are about, of prompt obedience to the directions they receive, of cleanliness, order, and modest behaviour—cannot but be of advantage to them in after life, whatever their station may be.'—WHATELY'S *Annotations on Bacon.*

(*a*) Point out and parse all the pronouns and prepositions in the above.

(*b*) What is a defective verb? Give examples from the above, and point out the manner in which such verbs are used.

2. What is the difference between prepositions and conjunctions?

Geography.

Answer *either* Q. 1 *or* Q. 3, *not both.*

1. What is the nearest seaport to your home? Trace, in words, a coasting voyage from it *either* to London, Liverpool, or Newcastle-on-Tyne, choosing whichever of the three is the most distant.

2. Draw a map of the coast from the head of the Gulf of Bothnia to the north-eastern corner of Russia in Europe.

3. Describe fully, as to children, the chief objects of interest to a traveller in Switzerland.

History.

1. Write down the names and dates of our sovereigns from Edward the Confessor to Henry II.

2. Which of the Plantagenet kings were called Lion-heart, Longshanks, and Crook-back? Give their dates, and name their immediate predecessors.

3. A list of English sovereigns from Edward IV. to Charles I.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Burglary.*

Write, in small hand, as a specimen of copy-setting, '*Now, Warwick, tell me, is Edward your true king?*'

Composition.

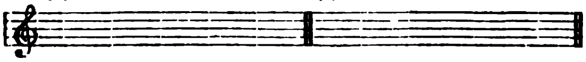
Write from memory the substance of the passage read to you by the Inspector.

Music.

A quarter of an hour allowed for this paper.

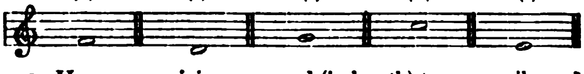
1. Write in (*a*) the scale of D (*Re*), and in (*b*) the scale of B♭ (*Se*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

(*a*) (*b*)



2. Place its third over (*a*), its fifth over (*b*), its fourth over (*c*), its second over (*d*), and its seventh over (*e*).

(*a*) (*b*) (*c*) (*d*) (*e*)



3. How many minims are equal (in length) to one semibreve? How many crotchets are equal (in length) to one minim? How many quavers are equal (in length) to a dotted crotchet?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. $$\frac{(1+\frac{1}{2}+\frac{2}{3}+\frac{3}{4})\times(\frac{4}{15}-\frac{3}{20})}{2\times 10\frac{8}{9}}$$

$$=\left\{\left(\frac{12+6+8+9}{12}\right)\times\left(\frac{16-9}{60}\right)\right\}\div\frac{196}{9}$$

$$=\frac{35\times 7\times 9}{12\times 60\times 196}=\frac{1}{64}.$$

And $\frac{1}{64}$ of £1·6=384d. $\times\frac{1}{64}$=6d. Ans.

2. 3·6 yards cost £$4\frac{11}{16}$;

∴ 32·88 yards cost £$4\frac{11}{16}\times\frac{32\cdot88}{3\cdot6}$,

32·88 yards cost £$\frac{75\times 32\cdot88}{16\times 3\cdot6}$,

32·88 yards cost £42, 16s. 3d.;

∴ we have (£50—£42, 16s. 3d.), or £7, 3s. 9d. remaining.

3. (*a*) $2\cdot\dot{2}$ guineas=£$\frac{20\times 21}{9\times 20}$=£$2\frac{1}{3}$

$\cdot41\dot{6}$ of £1=£$\frac{375}{900}$ = $\frac{5}{12}$

Total received, £$2\frac{3}{4}$

(*b*) 18·75 half-crowns=£$\frac{75}{4}\times\frac{1}{8}$=£$2\frac{11}{32}$=£$2\frac{11}{32}$

$\cdot\dot{3}5714\dot{2}8$ of 21s.=£$\frac{21}{20}\times\cdot3\frac{4}{7}$ = $\frac{3}{8}$= $\frac{12}{32}$

Total paid away=£$2\frac{23}{32}$

∴ the vulgar fraction of £1 remaining =(£$2\frac{24}{32}$—$2\frac{23}{32}$)=£$\frac{1}{32}$. Ans.

4. $\frac{9}{136}$ of $\cdot9\dot{4}=\frac{9\times 85}{136\times 90}=\frac{1}{16}$;

∴ $\frac{15}{16}$ of whole = $26\frac{1}{4}$ lbs.,

or $26\frac{1}{4}\times\frac{16}{15}=\frac{105\times 16}{4\times 15}$=28 lbs. Ans.

FEMALES.

1. (*a*)

£	s.	d.	£	s.	d.	£	
1537	3	4 :	960	14	7 ::	1	: dividend.
20			20				
30743			19214				
12			12				
368920d.			230575d.				

$\frac{20\text{s.}\times 230575}{368920}$=12s. 6d. 1st Ans.

(*b*) £276, 11s. 6d. at 12s. 6d. per £=

	£	s.	d.	
	276	11	6	
10s. = $\frac{1}{2}$ of £1	138	5	9	=dividend at 10s. in £.
2s. 6d. = $\frac{1}{4}$ of 10s.	34	11	$5\frac{1}{4}$	= ,, 2s. 6d. in £.
2d Ans. = £	172	17	$2\frac{1}{4}$	= ,, 12s. 6d. in £.

2. Square yards in 16 acres=4840 × 16;

∴ 22 square yards produce 440 bushels $\times\frac{22}{4840\times 16}$

,, ,, 440 bushels $\times\frac{1}{3520}$

,, ,, $\frac{1}{8}$ bushel. Ans.

3. 800 feet : 1800 feet :: $3\frac{1}{2}$ days,
700 feet : 960 feet,
12 hrs. : 14 hrs.,
7 men : 5 men.

$$\frac{7\text{ days}\times 5\times 14\times 960\times 1800}{2\times 7\times 12\times 700\times 800}=9\text{ days.}$$

4. 10 men : 15 men :: 12s.
$12\frac{1}{4}$ days : 7 days.

$$\frac{12\text{s.}\times 7\times 15\times 4}{10\times 49}=10\tfrac{2}{7}\text{s. Ans.}$$

1. (*a*) **Grammar.**

on—prep.	connecting	*children* with *act implied by engrafted.*
of—prep.	,,	*attention* with *habits.*
of—prep.	,,	*application* with *habits.*
to—prep.	,,	*that* (expressed in *what*) with *application.*
about—prep.	,,	*which* (expressed in *what*) with *state of being.*
of—prep.	,,	*obedience* with *habits.*
to—prep.	,,	*directions* with *obedience.*
of—prep.	,,	*cleanliness, order, behaviour*, with *habits.*
of—prep.	,,	*advantage* with *the state of being.*
to—prep.	,,	*them* with *advantage.*
in—prep.	,,	*life* with *advantage.*

what—rel. pron. (equivalent to *that which*). *That*, obj. case gov. by *to; which*, obj. case gov. by *about.*

they—pron. personal, 3d person plu. com. gender, nominative case, subj. of *are.*

they—(same as above) subj. of *receive.*

them—pron. personal, 3d pers. plu. com. gen. obj. case, gov. by *to.*

their—pronom. possessive adjective=possess. of *they.*

whatever—indefinite adj. pronoun, neut. nom. case, subj. of *may be.*

(*b*) A defective verb is one which wants some of its parts. The defective verbs in the given passage are *can* and *may.* They are used as auxiliaries to other verbs, the verb following them being in the infinitive mood, with the sign *to* omitted. The full expression in the passage is *cannot but* (*to*) *be, whatever their station may* (*to*) *be.*

2. Prepositions sustain towards single words the same relation which conjunctions sustain towards sentences. The word governed by the preposition always forms a phrase equivalent to an adverb, or a qualifying phrase equivalent to an adjective. With the conjunction, such a modifying or qualifying phrase could not be made.

Geography.

1. *See same question answered under Candidates in this number of the Magazine.*

3. CHIEF OBJECTS OF INTEREST IN SWITZERLAND.

(1) *Mountains and Valleys.*—Switzerland is altogether a mountainous country, two-thirds of its surface consisting of lofty mountain chains and Alpine valleys. The remainder is a high plain, elevated about thirteen hundred feet above the level of the sea. All the higher ranges of the Alps rise above the snow-line, and the immense quantities of snow collected on their summits are being continually dashed down their sides into the valleys below, where they often cause great devastation, sweeping trees and rocks before them, turning the courses of streams, and burying whole villages with all their inhabitants. These falls of snow are called *avalanches*, the distant noise of which is heard like the rolling of thunder, and warns the villagers of their approach. Sometimes *land-slips* occur, when large masses of earth and rocks are torn from the mountain-sides and dashed into the valleys.

(2) *Rivers.*—The numerous mountain-torrents of Switzerland form cataracts, and many of these are famed for their beauty. One of the most celebrated is that called the *Staubbach*, on a branch of the Aar, which is 800 feet high, and probably the loftiest cascade in Europe. The falls of the Rhine below *Schaffhausen* are also much celebrated.

(3) *Animals.*—Among native animals, the *ibex* and the *chamois* are the most characteristic. The Alpine *marmot*, too, is very interesting, forming among the mountains families which burrow underground and spend the winter in a state of lethargy. Of domestic quadrupeds, every one has heard of the famous breed of Alpine spaniels kept by the monks of St. Bernard, which display such wonderful sagacity in rescuing travellers from the snow. The convent of St. Bernard, situated 7963 feet above the sea, is near the summit of the mountain pass, and in a region where numerous avalanches occur. These dogs are trained to seek travellers who may have lost their way, being furnished with a basket of provisions fastened round the neck. Many stories have been written about these dogs.

(4) *People.*—As the soil seems by nature designed for feeding cattle, the cows, goats, and sheep are the wealth of the Swiss farmer. In summer the cattle go to the mountains for pasture, when the herdsmen live in rude huts or *chalets*, where cheese and butter are made. In winter the cattle return to the lower grounds. The making of watches, musical boxes, and jewellery is an especial characteristic of the Swiss. Education is in a very advanced state, elementary instruction being spread among all classes, and their methods of teaching have furnished models for imitation in all parts of Europe.

History.

			A.D.
1.	Edward the Confessor	began to reign	1042
	Harold II.	,,	1066
	William the Conqueror	,,	1066
	William Rufus	,,	1087
	Henry I.	,,	1100
	Stephen	,,	1135
	Henry II.	,,	1154

2. Richard I. (Lion-heart) began to reign 1189 A.D.; was succeeded by John.

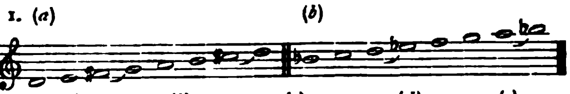
Edward I. (Longshanks) began to reign 1272 A.D.; was succeeded by Edward II.

Richard III. (Crook-back) began to reign 1483 A.D.; was succeeded by Henry VII.

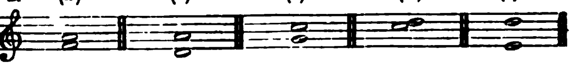
			A.D.
3.	Edward IV.	began to reign	1461
	Edward V.	,,	1483
	Richard III.	,,	1483
	Henry VII.	,,	1485
	Henry VIII.	,,	1509
	Edward VI.	,,	1547
	Mary	,,	1553
	Elizabeth	,,	1558
	James I.	,,	1603
	Charles I.	,,	1625

Music.

1. (*a*) (*b*)



2. (*a*) (*b*) (*c*) (*d*) (*e*)



3. Two.
Two.
Three.

SECOND YEAR.

Pupil Teachers at end of Second Year.

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. At what rate per cent. per annum will the simple interest on £1043, 15s. amount to £121, 15s. 5d. in $2\frac{1}{12}$ years?

2. What sum lent for 125 days at $6\frac{1}{8}$ per cent. per annum will give £10, 9s. $3\frac{1}{4}$d. interest?

3. Share £150 among A, B, C, D, so that A may have $11\frac{1}{9}$ per cent. of it, B $5\frac{5}{9}$ per cent. of it, C $33\frac{1}{3}$ per cent. of it, and D the remainder of the money. How much will each receive, and what percentage of the whole will fall to D?

4. Find the difference between the simple and compound interest on £360 for 3 years at 5 per cent. per annum.

FEMALES.

1. Reduce the expression $\left(\frac{3\frac{1}{3}}{7}+\frac{2}{10\frac{1}{2}}-\frac{5}{18}\text{ of }\frac{4}{7}\right)\times 1\frac{3}{4}$ to its simplest form.

2. What number added to $\frac{3}{4}$ of $(\frac{1}{3}+\frac{1}{5}-\frac{4}{15}+\frac{1}{3})$ makes $3\frac{1}{4}$; and what number divided by $\frac{1}{4}$ of $\frac{1}{3}$ of $\frac{1}{6}$ will give $\frac{64}{315}$?

3. After taking from a bag $\frac{1}{4}$ of my money, I find that $\frac{3}{5}$ of what is then left amounts to 7s. 6d.; what money was there in the bag at first?

4. What part of $\frac{1}{3}$ of a ton is $2\frac{3}{5}$ of $1\frac{1}{3}$ of $\frac{1}{4}$ of a cwt.?

Grammar.

1. 'Men were meant to fill the earth and to conquer it, as they are doing at this day. They were meant to become hardy and industrious, to be forced to use their hands and their heads to the utmost stretch, to call out into practice all the powers which lay ready in them.'

(*a*) Point out the extensions of the predicate that occur in the above passage.

(*b*) Point out and parse all the participles and verbs in the infinitive mood that occur in the above, and show in what important respect they differ from finite verbs.

(*c*) What kind of sentence is that in the above, which is joined to the principal sentence by the conjunction 'as'? Give other examples of like sentences.

Geography.

Answer *either* Question 1 *or* Question 2, *not both*.

1. Give notes of a lesson on 'The chief objects of interest to a traveller in Switzerland.'
2. Describe fully the physical features and general character of Natal, New Zealand, Labuan, Hong Kong, Mauritius, and St. Helena.
3. Draw a full map of the Bay of Bengal.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. How was the Witena-gemôt composed? and what were its powers?
2. Give the names of Henry the Second's wife and sons, and their conduct towards him.
3. Who was the Queen of Edward IV.? Mention the names, titles, and fate of her sons.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Burglary.*

Write, in small hand, as a specimen of copy-setting, '*Now, Warwick, tell me, is Edward your true king?*'

Composition.

Write full notes of a lesson on *Clouds and their uses.*

Euclid.

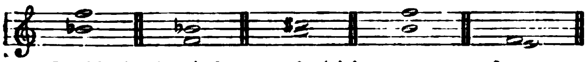
[All generally-understood abbreviations for *words* may be used, but no symbols of *operation*, such as —, +, ×, are admissible.]

1. Define *plane angle, circle, rhombus, axiom.* When are two magnitudes said to be equal to one another?
2. From the greater of two given straight lines to cut off a part equal to the less.
What are the *data* and what are the *quæsita* in this problem?
3. If two straight lines cut one another, the vertical or opposite angles shall be equal.
State, and work out, the corollaries.

Music.

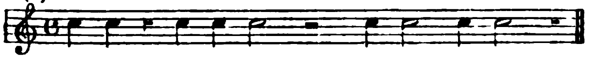
A quarter of an hour allowed for this paper.

1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms :—



2. Divide (by bars) the notes in (*a*) into measures of common time; those in (*b*) into measures of triple.

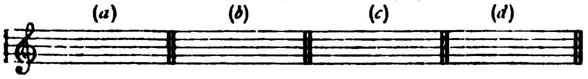
(*a*)



(*b*)

3. Write in (*a*) the signature of G (*Sol*), in (*b*) that of F (*Fa*), in (*c*) that of D (*Re*), and in (*d*) that of B♭ (*Se*).

(*a*) (*b*) (*c*) (*d*)



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. Interest on £1043¾ for $2\frac{1}{12}$ yrs. = £121, 15s. 5d. = 29225d.;

∴ ,, £100 ,, 1 yr. $= 29225\text{d.} \times \frac{100 \times 4 \times 12}{4175 \times 25}$;

,, ,, ,, ,, = 1344d.;

,, ,, ,, ,, = £5⅗. Ans.

2.
£6⅛ would be gained in 365 days by £100;

∴ £10, 9s. 3¼d. ,, 125 ,, ,, $£100 \times \frac{£10, 9\text{s}. 3\frac{1}{4}\text{d}.}{£6\frac{1}{8}} \times \frac{365}{125}$;

,, ,, ,, ,, ,, $£100 \times \frac{10045 \text{ far.}}{5880} \times \frac{365}{125}$,

i.e. £498, 16s. 8d. Ans.

3.

		£	s.	d.	
$11\frac{1}{9}$ p. c. of £150 $= \frac{100}{900}$	of £150 =	16	13	4	A's share,
$5\frac{5}{9}$,, ,, $= \frac{50}{900}$	,, =	8	6	8	B's ,,
$33\frac{1}{3}$,, ,, $= \frac{300}{900}$	,, =	50	0	0	C's ,,

D's share is therefore £75, or 50 per cent. of the whole.

4. (*a*) Simple interest $= £360 \times \frac{3 \times 5}{100} = £54.$

(*b*) Compound interest is found below :—
5 per cent. per annum = $\frac{1}{20}$ of principal.

£	s.	d.	
360	0	0	principal for 1st year.
18	0	0	interest ,,
378	0	0	principal for 2d year.
18	18	0	interest ,,
396	18	0	principal for 3d year.
19	16	10⅘	interest ,,
416	14	10⅘	amount for 3d year.
360	0	0	principal at beginning.
56	14	10⅘	compound interest.
54	0	0	simple ,,
Ans. £2	14	10⅘	difference required.

FEMALES.

1. The next form of the expression is

$$\left(\frac{10}{21} + \frac{4}{21} - \frac{10}{63}\right) \times \frac{7}{4}$$

$$= \frac{30 + 12 - 10}{63} \times \frac{7}{4} = \frac{32 \times 7}{63 \times 4} = \frac{8}{9}. \text{ Ans.}$$

2. (*a*) The next form of the expression is

$$\frac{13}{4} - \frac{3}{4} \times \left(\frac{15 + 9 - 12 + 5}{45}\right)$$

$$= \frac{13}{4} - \frac{3 \times 17}{4 \times 45} = \frac{13}{4} - \frac{17}{60}$$

$$= \frac{195 - 17}{60} = 2\frac{29}{30}. \text{ Ans.}$$

(*b*) $\frac{64}{315} \times \frac{1}{4} \text{ of } \frac{1}{6} \text{ of } \frac{1}{8}$

$$= \frac{64}{315 \times 4 \times 6 \times 8} = \frac{1}{945}. \text{ Ans.}$$

3. By taking away ¼ there remains ¾.
Now ⅔ of ¾ = 7s. 6d.,
or ½ = 7s. 6d.;
∴ the whole must be 15s. Ans.

4. $\frac{2\frac{2}{3} \text{ of } 1\frac{1}{3} \text{ of } \frac{1}{7} \text{ cwt.}}{\frac{1}{3} \text{ ton}} = \frac{\frac{8}{3} \times \frac{4}{3} \times \frac{1}{7} \text{ cwt.}}{6\frac{2}{3} \text{ cwt.}}$

$$= \frac{8 \times 4 \times 1 \times 3}{3 \times 3 \times 7 \times 20} = \frac{8}{105}. \text{ Ans.}$$

Grammar.

1. (*a*) The extensions of the predicate are :—(1) *to fill the earth* (*as they are doing at this day*); (2) *to conquer it, as they are doing at this day*; (3) *to become hardy and industrious*; (4) *to be forced to use their hands and their heads to the utmost stretch*; (5) *to call out into practice all the powers which lay ready in them.*

(*b*) *meant*—trans. verb, complete part. strong conj. (*mean, meant, meant*), agreeing with *men.*

to fill—trans. verb, infinitive mood, pres. indef. tense, weak conj. gov. by *meant.*

to conquer—trans. verb, infin. mood, pres. indef. tense, weak conj. gov. by *meant.*

doing—verb, incomplete part. strong conj. (*do, did, done*), agreeing with *they.*

meant—trans. verb, complete part. strong conj. (*mean, meant, meant*), agreeing with *men*.
to become—intrans. verb, infin. mood, pres. indef. tense, strong conj. (*become, became, become*), gov. by *meant*.
to be—verb, incomplete, infin. mood, pres. indef. tense, conj. *am, was, been*, gov. by *meant*.
forced—trans. verb, complete part. weak conj. agreeing with *they*.
to use—trans. verb, infin. mood, pres. indef. tense, weak conj. gov. by *forced*.
to call out—compound trans. verb, infin. mood, pres. indef. tense, weak conj. gov. by *meant*.

The *infinitive mood* differs from the *finite* verb in making no statement whatever, but simply setting before the mind the notion expressed by the verb.

(*c*) The sentence beginning with 'as' is a *subordinate adverbial sentence*. Other sentences are :—Do as *you are bid*. Come *when he tells you*. He went away *while you were speaking*.

Geography.

1. *See same question fully answered under First Year in this number of Magazine.*

2. *Natal.*—The country rises in three terraces towards the mountains. The first lies along the shore, is highly fertile, and is tropical in climate and vegetation. The second rises 800 feet high; and the third is divided into (1) *Midlands*, yielding the produce of South Europe; and (2) *Uplands*, which portion has a climate and productions very similar to our own. The *Drakenberg Mountains* are the chief. The rivers are numerous, but none of them navigable to any extent. The largest is the *Tugela*, which, with its tributary the Buffalo, forms the northern boundary.

New Zealand.—The coast-line of North Island is remarkable for the very numerous inlets it contains. South Island is but little indented except at its northern end. New Zealand may be called a wooded highland country, clothed with a luxuriance of vegetation. The centre of North Island is occupied by broad and lofty mountains, which send off spurs to the sea-coast. South Island is traversed its entire length by a mountain range, which runs nearer the western than the eastern coast. North Island is very volcanic in character, and three distinct lines of craters occur in it. There are numerous rivers, but these are for the most part small. One of the most striking features of the colony is the abundance of water and water-power. The river valleys, at first narrow and confined, open out, as the rivers approach the sea, into broad fertile districts.

Labuan.—This island is well supplied with water, has a good harbour at Victoria, and abounds in excellent coal. Edible birds'-nests, a luxury of the Chinese, are exported from this island.

Hong Kong.—This island consists of barren granite rocks, rising to a height of one or two thousand feet. Water is abundant, and the climate, though warm, is considered healthy. Its capital, Victoria, stands on a splendid harbour.

Mauritius.—This is an oval-shaped island, evidently of volcanic origin. The interior contains numerous hills and mountains, mostly occurring as short isolated ridges. Fertile plains and valleys are abundant, watered by streams which become periodically dry. The climate, though damp, is healthy, but the island is exposed at times to most terrific hurricanes, which do great damage.

St. Helena.—This small island forms towards the sea a wall of precipitous cliffs, intersected by chasms which open into narrow valleys, leading up to the table-land in the centre. The climate is one of the healthiest within the tropics. It is not too warm, as there is always a good breeze, the island lying in the strength of the south-east trade-wind.

History.

1. By right every freeman was a member of the Witena-gemôt, or assembly of the wise. Latterly, when the kingdom grew in extent, it was attended only by the Ealdormen, who were something like viceroys. The powers of the Witan were large. It could elect or depose the king, it dealt with higher justice, imposed taxes, made laws, concluded treaties or declared war, disposed of the public lands, and appointed the great officers of state.

2. Henry II. married Eleanor, the divorced queen of Louis VII. of France, and his sons were Henry, Richard, Geoffrey, and John, who, urged on by their mother, rebelled against their father to dethrone him.

3. The queen of Edward IV. was Elizabeth Woodville, daughter of Lord Rivers, and widow of Sir John Grey. Her sons were Edward V. and Richard, Duke of York. They were *murdered* in the Tower, it was said, by the orders of their uncle, Richard III., who had usurped the crown.

Composition.

NOTES OF A LESSON ON CLOUDS.

Evaporation.—From every exposed piece of water warmed by the sun there is rising an invisible watery vapour, slowly and quietly, into the atmosphere. This process called *evaporation*. Call attention to the boiling of water, and steam issuing from spout of a kettle, steam invisible close to spout.

Condensation.—So long as vapour remains heated it is invisible; whenever laden air becomes sufficiently cooled, its burden of moisture makes its appearance as a *cloud*. Call attention to clouds of steam from spout of kettle or from funnel of engine.

Rain.—If the cooling (or condensation, as it is called) continues, the cloud descends in the form of rain. Call attention to fogs, which are clouds close to the ground—hail—snow.

Forms of Clouds.—White and fleecy, sometimes curled like feathers; these very far up. Dense and heaped up; again extending in continuous sheets. Sometimes clouds of different forms intermingle. Call attention to appearance of clouds while giving lesson.

Uses of Clouds.—No clouds no rain. Call attention to deserts; scarcity of water; the value of rain in some parts of India and Africa; effects of drought; the cool screen that clouds make in summer for tender plants which the sun might shrivel up; the pleasure to be got from watching their shapes. Clouds may be studied to get a knowledge of probable weather.

Euclid.

1. A *plane angle* is the inclination of two lines to each other in a plane, which meet together, but are not in the same direction.

A *circle* is a plane figure contained by one line which is called the circumference, and is such that all straight lines drawn from a certain point (called the centre) within the figure to the circumference are equal to one another.

A *rhombus* is a four-sided figure which has all its sides equal, but its angles are not right angles.

An *axiom* is a theorem, the truth of which is admitted without proof.

Two magnitudes are said to be equal to one another when they coincide with one another—that is, when they exactly fill the same space.

2. Prop. 3, Book I.

Data, two straight lines of unequal length. Quæsita, cutting off a part equal to the less.

3. Prop. 15, Book I.

First Corollary.—If two straight lines cut one another, the angles which they make at the point where they cut are together equal to four right angles.

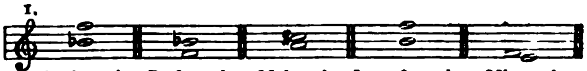
Proof.—For the two angles on each side of one line are together equal to two right angles (Prop. 13), and therefore the four are together equal to four right angles.

Second Corollary.—All the angles made by any number of lines meeting in one point are together equal to four right angles.

Proof.—From the above corollary it is evident that though a great number of angles be made by drawing straight lines through the same point, yet the original four angles have nothing more added, but are merely subdivided.

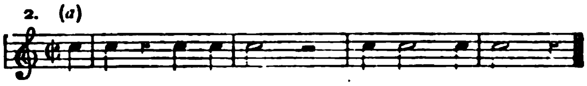
Music.

1.

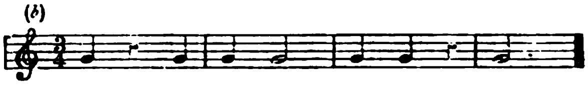


Perfect 5th. Perfect 4th. Major 3d. Imperfect 5th. Minor 2d.

2. (*a*)



(*b*)



3. (*a*) (*b*) (*c*) (*d*)

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May* **1878; and Pupil Teachers at end of Fourth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. To what sum will £480 amount, in 3 years, at 5 per cent. per annum compound interest?

2. By selling 5505½ articles at a profit of 66·6 per cent., I made a clear gain of £2385, 14s. 4d. What did the articles cost me per score?

3. If the rent of a farm of 17 ac. 3 ro. 2 po. be £39, 4s. 7d., what would be the rent of another farm containing 26 ac. 2 ro. 23 po. if 6 acres of the former be worth 7 acres of the latter?

4. A has to perform a journey of 46 miles, which he can do in 10 hours; B can do the same in 13 hours. If they are started at the same moment from opposite ends of the journey and walk towards each other, in how many hours will they meet, and what number of miles will each travel?

FEMALES.

1. Divide 1121·4 by ·534, and 172·9 by ·142 to three places of decimals.

2. Find the value of ·375 of a guinea + ·54 of 8s. 3d. + ·017 of £2, 15s.

3. Find the value of $\frac{133}{400}$ of $3\frac{3}{8}$ tons − ·3405 of $1\frac{3}{8}$ qrs. + $\frac{\cdot 213348}{\cdot 326}$ of 2 cwt. 102 lbs.

Grammar.

1. 'Impostor! do not charge most innocent Nature,
As if she would her children should be riotous
With her abundance; she, good cateress,
Means her provision only to the good,
That live according to her sober laws,
And holy dictate of spare temperance.'

MILTON'S *Comus.*

(*a*) Analyse the principal sentences in the above.

(*b*) What is meant by words being 'in apposition'? Point out any example of this construction that you notice in the above.

(*c*) Give the meaning of the above passage in your own words.

(*d*) Parse all the words in the first two lines.

2. What are the Latin prepositions that mean *under, with?* Give examples of words compounded with them, and show how the spelling of these prepositions varies in *composition.*

Geography.

Answer *either* Q. 2 *or* Q. 3, *not both.*

1. Give full notes of a lesson on this sentence in a letter from a young man in Ceylon:—

'I have just returned to this island from a coasting voyage round the Bay of Bengal, in which I have carefully examined every seaport, the mouth of every river, and have studied the general character of the country on each side of the Bay.'

Draw a map in illustration.

2. Describe a journey by land from the mountains of Abyssinia to Jerusalem.

3. Describe, in order, the rivers flowing into the Indian Ocean and its branches.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. Tell the names and fate of the wives of Henry VIII.

2. What was the condition of the Netherlands in the time of Elizabeth? Describe the part taken by England, and tell what you know about Sir Philip Sidney.

3. When and under what circumstances did (*a*) Wales, (*b*) Scotland, and (*c*) Ireland first send members to the English Parliament?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Burglary.*

Write, in small hand, as a specimen of copy-setting, '*Now, Warwick, tell me, is Edward your true king?*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally-understood abbreviations for *words* may be used, but symbols of *operations,* such as −, +, ×, are not admissible.]

1. In the base BC of a triangle ABC any point D is taken. Draw a straight line such that if the triangle ABC be folded along this straight line, the point A shall fall upon the point D.

2. If a straight line falling upon two other straight lines, make the exterior angle equal to the interior and opposite upon the same side of the line; or make the interior angles upon the same side together equal to two right angles; the two straight lines shall be parallel to one another.

3. Parallelograms upon the same base, and between the same parallels, are equal to one another.

Are the parallelograms equal in all respects?

Algebra.

1. Simplify $1\frac{1}{2}-\frac{3}{4}\{1-\frac{2}{3}(x-\frac{1}{2})\}$, and cube the result.

2. Reduce to lowest terms $\frac{x^2+x-12}{x^3-5x^2+7x-3}$.

3. Solve the equations:—

$$(1)\quad \tfrac{1}{2}(9-2x)=\frac{3}{2}-\frac{7x-18}{10}.$$

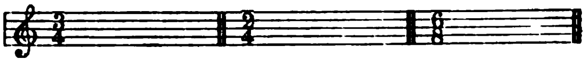
$$(2)\quad \frac{13+6x}{15}-\frac{2x}{5}=\frac{3x+5}{5x-25}.$$

Music.

A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of C (*Do*). Mark the places of the semitones:—

2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures:—



3. Write over each of the following the name of the major scale, and under each that of the minor scale, of which it is the signature:—

ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1.

	£	s.	d.	
	480	0	0	principal for 1st year.
5 p. c. per annum = $\frac{1}{20}$ of principal.	24	0	0	interest ,,
	504	0	0	principal for 2d year.
	25	4	0	interest ,,
	529	4	0	principal for 3d year.
	26	9	2¾	interest ,,
£	555	13	2¾	amount. Ans.

2. $66\cdot\dot{6}$ per cent. $= \frac{66\frac{2}{3}}{100} = \frac{2}{3}$;

$\therefore$ prime cost $= £2385,\ 14s.\ 4d. \times \frac{3}{2}$;

,, $= £3578,\ 11s.\ 6d.$;

$\therefore$ 1 score cost $£3578,\ 11s.\ 6d. \times \frac{20}{5505\frac{1}{2}}$,

i.e. $£\frac{143143}{11011}$,

i.e. £13. Ans.

3. Rent required $= £39,\ 4s.\ 7d. \times \frac{26\text{ ac. } 2\text{ ro. } 23\text{ po.}}{17\text{ ac. } 3\text{ ro. } 2\text{ po.}} \times \frac{7}{6}$,

,, $= £39,\ 4s.\ 7d. \times \frac{4263\text{ po.}}{2842\text{ po.}} \times \frac{7}{6}$,

,, $= £39,\ 4s.\ 7d. \times \frac{7}{4}$,

,, $= £68,\ 13s.\ 0\frac{1}{4}d.$ Ans.

4. (*a*) A performs $\frac{1}{10}$ of the journey in 1 hour or $\frac{13}{130}$.
B ,, $\frac{1}{13}$,, ,, ,, or $\frac{10}{130}$;
$\therefore$ by starting from different ends, A performs 13 parts of the journey, while B does 10, or together they perform 23 parts.

$\frac{13}{23}$ of 46 miles = 26 miles for A. Ans.
$\frac{10}{23}$,, = 20 ,, B. Ans.

(*b*) They will meet in the time taken by A to travel 26 miles, or time taken by B to travel 20 miles.

If A travels 46 miles in 10 hours, he will travel 26 miles in 10 hrs. $\times \frac{26}{46} = 5\frac{15}{23}$ hrs. Ans.

FEMALES.

1. (*a*)

```
·534)1121·411(2100. Ans.
     1068
     ----
       534
       534
```

(*b*)

```
·142)172·9(1217·605. Ans.
     142
     ---
      309
      284
      ---
       250
       142
       ----
       1080
        994
        ---
         860
         852
         ---
          800
          700
```

2.

			s.	d.
·375 guinea	$= \frac{3}{8}$ of 21s.	=	7	$10\frac{1}{2}$
$\cdot\dot{5}\dot{4}$ of 8s. 3d.	$= \frac{6}{11}$ of 99d.	=	4	6
$\cdot0\dot{2}\dot{7}$ of £2, 15s.	$= \frac{3}{110}$ of 55s.	=	1	6
		By addition,	13	$10\frac{1}{2}$ Ans.

3.

		tons	cwt.	qrs.	lbs.	
$\frac{133}{400}$ of $3\frac{3}{4}$ tons $= \frac{15}{4}$ tons $\times \frac{133}{400}$	=	1	4	3	21	
$\cdot3\dot{4}0\dot{5}$ of $1\frac{2}{3}$ qrs. $= \frac{5}{3}$ qrs. $\times \frac{63}{185}$	=				$15\frac{33}{37}$	
By subtraction,		1	4	3	$5\frac{4}{37}$	$= \frac{1800}{16650}$

$\frac{\cdot21334\dot{8}}{\cdot326}$ of 2 cwt. 102 lbs.

$= 326\text{ lbs.} \times \frac{\cdot21334\dot{8}}{\cdot326}$

$= 1000\text{ lbs.} \times \cdot21334\dot{8}$

$= 213\cdot34\dot{8}\text{ lbs.} = \quad 1 \quad 3 \quad 17\frac{157}{450} = \frac{5809}{16650}$

By addition, $1 \quad 6 \quad 2 \quad 22\frac{7609}{16650}$.

Grammar.

1. (*a*)

Principal Sentence.	Subject and Enlargement.	Predicate.	Object and Enlargement.	Extensions.
(1) Impostor! do not charge most innocent Nature.	(*Thou*) impostor!	do not charge	most innocent Nature	...
(2) She, good cateress, means her provision only to the good.	She, good cateress,	means	her provision	only, to the good (*dative object*)

(*b*) By words in 'apposition' are meant nouns or pronouns which are attached to other nouns or pronouns without any connective, and refer to the same person or thing. The second word is said to be in 'apposition' with the former, and agrees with it in case; as, Impostor! (*thou*) (voc.); she, *good cateress*.

(*c*) You deceiver! would you groundlessly accuse Nature of desiring men to wantonly consume the luxuries which she has unsparingly bestowed on them? Far from being guilty of such a wish, she, like a thrifty provider, intends her good things only for the prudent, who use them according to the laws of temperance and sobriety.

(*d*) *Impostor*—noun, masc. gen. sing. num. voc. case (nom. of address).
do not charge—trans. verb, emphat. neg. form, imperative mood, weak conj. 2d pers. sing. agr. with (*thou*).
most—adverb of degree, forming with
innocent—the superlative degree of an adj. qual. *Nature*.
Nature—noun (=proper noun), fem. gen. sing. num. obj. gov. by *charge*.
as if—conj. phrase, connecting a subord. sent. with a principal.
she—pers. pron. 3d pers. sing. fem. nom. case, subj. of *would*.
would—defect. verb, subj. mood, past indef. tense, 3d pers. sing. agreeing with subj. *she*.
her—pronom. poss. adjective, qual. *children*.
children—com. noun, com. gender, plu. num. nom. case, subj. of *should be*.
should be—verb, incomplete (*am, was, been*), subjunctive mood, pres. indef. tense, 3d pers. plu. agreeing with subj. *children*.

NOTE.—*Should be* is periphrastic, and equivalent to 'be.'

2. *Sub* is the Latin preposition for 'under,' and takes in composition the forms *suc, suf, sug, sum, sup, sur, sus*; as, *sub*altern, *sub*lime, *suc*ceed, *suf*fuse, *sug*gest, *sum*mon, *sup*plant, *sur*rogate, *sus*pend.

Cum is the Latin preposition for 'with,' and takes the forms *com, col, con, cor, co*; as, *com*bat, *col*lapse, *cor*rect, *co*gnate, *co*-operate.

Geography.

1. NOTES ON BAY OF BENGAL.

Seaports.—*Amherst*; *Moulmein*, exports timber, much shipbuilding; *Martaban*; *Rangoon*, a most important town, exports teak, well fortified; *Calcutta*, capital of British India, taken by Clive 1757; *Pooree*, also called Juggernaut, from famous Hindoo temple; *Masulipatam*; *Madras*, situated on a surf-beaten shore—vessels lie in the roads two miles off.

River-mouths.—*Saluen*; *Irrawady* has a large delta: Rangoon sits on the only branch that is always navigable; *Brahmapootra*, its lower course may be considered as forming part of the delta of the Ganges; *Ganges*, 300 miles from the sea, begins its lower course, which flows through a peculiar delta, whose uninhabitable marsh, as large as Wales, is called the *Sunderbunds*. The most eastern stream is called *Ganges*, and the western *Hooghly*. *Mahanuddy* has a considerable delta, which forms the province of Cuttack. *Godavery*, chief river of the Deccan, forms a small delta; its port is *Coringa*. *Kistnah* has also a delta; its port is Masulipatam. *S. Pennair*, the French settlement of Pondicherry, stands at its mouth. *Cauvery* forms a very large delta.

General Character of Countries.—*British Burmah.*—Climate well suited for Europeans; rich in minerals—coal, tin, copper, and limestone; products—cotton, rice, and timber. *Assam.*—

Watered by the Brahmapootra; surface flat; might be the best manufacturing district in India. *Bengal.*—A great alluvial plain. The *Sunderbunds.*—Jungle and marsh; climate tropical; majority of people agricultural; great variety of products. *Madras.*—Greater part artificially irrigated; climate excessively hot; forests extensive and valuable; cinchona plantations in the Neilgherries. *Eastern Ghauts* run comparatively close along the west coast of the Bay.

2. In journeying by land from the mountains of Abyssinia to Jerusalem, the most convenient route will be to follow the *Tacazze*, a tributary of the Nile. Beginning among the mountains, say at the site of *Magdala*, which was taken by the British under Napier in 1868, we follow the Tacazze till it changes into the *Atbara*, the third great tributary of the Nile, the most wonderful river in the world. Following the windings of the river through *Nubia*, we continue our journey along its limited valley, passing the towns of *Berber*, *Dongola*, *Ipsambool*, and *Derr*. Entering *Egypt*, we find that this country depends on the Nile for its fertility. We may visit on our way the interesting ruins of *Thebes*, and the towns of *Kenneh*, *Siout*, *Ghizeh*, and *Cairo*. We may now turn east to the *Suez Canal*, crossing which we strike across the desert, following if we choose the route which the Israelites took in journeying from Egypt to the Holy Land, crossing into *Palestine* by the southern boundary, and arriving at *Jerusalem*, our destination, through the ancient tribe of Judah, visiting those places which have been identified with *Engedi*, *Hebron*, *Bethlehem*, etc.

3. RIVERS.

FLOWING INTO THE INDIAN OCEAN AND ITS BRANCHES.			
	River	*Flowing through*	*Direction.*
In Africa.	Limpopo.	Transvaal, Sofala.	East.
	Zambesi.	South Africa.	Easterly.
In Asia.	Euphrates.	Asia Minor.	South.
	Tigris.	,,	,,
	Indus.	India.	,,
	Nerbudda.	,,	West.
	Taptee.	,,	,,
	Cauvery.	,,	East.
	Kristnah.	,,	,,
	Godavery.	,,	,,
	Mahanuddy.	,,	,,
	Ganges.	,,	,,
	Brahmapootra.	,,	East and south.
	Irrawady.	,,	South.
In Australia.	Murray.	Divides N. S. Wales from Victoria.	Westerly.
	Swan.	West Australia.	,,
	Murchison.	,,	,,

History.

1. The wives of Henry VIII. were:—
   (1) Catherine of Aragon—divorced.
   (2) Anne Boleyn—beheaded 1536.
   (3) Jane Seymour—died in child-birth.
   (4) Anne of Cleves—divorced.
   (5) Catherine Howard—beheaded.
   (6) Catherine Parr — survived Henry; married Sir Thomas Seymour.

2. In the time of Elizabeth the people of the Netherlands were in revolt against their sovereign, Philip of Spain. Being Protestants they got assistance from the Queen, who sent an expedition under the command of the Earl of Leicester. The expedition effected nothing, but is memorable for an incident which took place at the battle of Zutphen. In this battle Sir Philip Sidney, who, for his talents as a statesman, soldier, and scholar, was the darling of England, received a wound which proved mortal. While he was raising a bottle to his lips to quench his thirst, he observed a dying soldier look wistfully at it. Without tasting the contents, he handed the bottle to the soldier, saying, 'Thy necessity is yet greater than mine.'

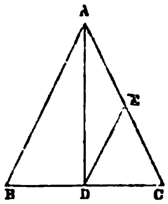
3. (*a*) Wales was incorporated in a legislative union with England (1536) in the reign of Henry VIII., and the English laws and liberties were granted to the inhabitants.

(*b*) Scotland was united in a similar manner in the reign of Anne (1707). England, Wales, and Scotland had only one Parliament, and they were included under the common name of Great Britain.

(*c*) After the Irish rebellion of 1798 had been quelled, Ireland sent members to the British Parliament in London, according to the Treaty of Union, Jan. 1, 1801.

Euclid.

1. Let any point D be taken in the base BC of the triangle ABC. Join DA, and at the point D in the straight line DA make the angle ADE equal to the angle EAD. Then AE is equal to ED (Prop. 5, Bk. 1); and if the triangle ABC be folded over along the line ED, the point A will fall on the point D. Another line can be drawn on the other side of AD to answer the requirements of the problem.



2. Prop. 28, Book 1.
3. Prop. 35, Book 1.

The parallelograms are not necessarily equal in all respects.

Algebra.

1. $$1\frac{1}{2}-\frac{3}{4}\left\{1-\frac{2}{3}\left(x-\frac{1}{2}\right)\right\}$$
$$=\frac{3}{2}-\frac{3}{4}\left(1-\frac{2x}{3}+\frac{1}{3}\right)$$
$$=\frac{3}{2}-\frac{3}{4}+\frac{x}{2}+\frac{1}{4}$$
$$=\frac{x}{2}+\frac{1}{2},$$
and $\left(\frac{x}{2}+\frac{1}{2}\right)^3=\frac{x^3}{8}+\frac{3x^2}{8}+\frac{3x}{8}+\frac{1}{8}$. Ans.

Or $\frac{1}{8}(x^3+3x^2+3x+1)$.

2. $$\frac{x^2+x-12}{x^3-5x^2+7x-3}=\frac{(x-3)(x+4)}{(x-3)(x-1)^2}=\frac{x+4}{(x-1)^2(x-1)}.$$

3. (1) L. C. M. of denominators $=10$;
$$\therefore 45-10x=15-7x+18,$$
$$7x-10x=15+18-45,$$
$$3x=12,$$
$$x=4. \text{ Ans.}$$

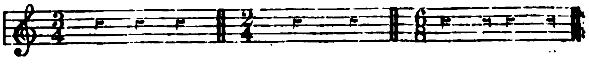
(2) $$\frac{13+6x}{15}-\frac{2x}{5}=\frac{3x+15}{5x-25},$$
or $$\frac{13+6x-6x}{15}=\frac{3x+15}{5x-25},$$
$$\frac{13}{15}=\frac{3x+15}{5x-25}.$$

L. C. M. of denominators $=15x-75$;
$$\therefore 13x-65=9x+45,$$
$$13x-9x=45+65,$$
$$4x=110,$$
$$x=27\tfrac{1}{2}. \text{ Ans.}$$

Music.

1.

2.



3.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May* 1878; **and Pupil Teachers at end of Fifth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What sum of money lent at $4\frac{1}{2}$ per cent. per annum for $\cdot 41\dot{6}$ of a year will produce £24·4375 interest?
2. A draper sells 104 yards of lace for £$138\frac{2}{3}$, and thereby loses 10 per cent. At what price per yard should he sell the lace in order to gain 8 per cent.?
3. A bankrupt owes A £256, 6s. 8d., B £203, 10s. 0d., C £141, 13s. 4d.; his estate is worth £421, 1s. 0d.; how much will A, B, C receive respectively?
4. If the 3 per cent. be at 96, how much must a person invest in order that he may derive from it a half-yearly interest of £77, 13s. 4d., after paying 7d. in the £ for income tax?
5. Divide £350 into four shares which shall have the same ratio to one another as the cubes of 1, 2, 3, 4 respectively.

FEMALES.

1. What is the price of 7 packages of cloth, each package containing 7 parcels, each parcel 27 pieces, and each piece 81 yards, at the rate of $1\frac{1}{3}$ guineas for 3 yards?
2. If 252 men can dig a trench 210 yards long, 3 wide, and 2 deep, in 5 days of 11 hours each, in how many days of 11 hours each will 22 men dig a trench of 420 yards long, 5 wide, and 3 deep?
3. Find the simple interest on £98, 15s. 10d. for $\frac{1}{2}$ a year at $2\frac{1}{2}$ per cent.
4. What was the prime cost of an article which, when sold for 12s., realized a profit of 20 per cent.?

Grammar.

1. '*Shall* courtesy *be done* only to the rich, and only by the rich? In good breeding, which differs, *if at all*, from high breeding only as it gracefully remembers the rights of *others* rather than gracefully *insists* on its own rights, I discern no special connection with wealth or birth; but rather *that* it lies in human nature *itself*, and is *due* from all men towards all men.'—CARLYLE, *Sartor Resartus.*

(*a*) Point out any words in the above which seem to you to be of Latin or of French origin, and give, if you can, a particular account of one of them.

(*b*) Parse the words in italics.

(*c*) Analyse from '*In good breeding*' to '*wealth or birth.*'

2. What was the original possessive of *it* (its being a modern form); give examples of its use.

Geography.

1. Give notes of a lesson on 'The great rivers of South America,' under these heads:—
   (*a*) Position of sources.
   (*b*) General direction.
   (*c*) Length and size, as compared with European rivers.
   (*d*) Character of country through which they flow.

   Illustrate by a map, showing *one* basin.
2. Describe the boundaries, extent, and character of the Indian Ocean.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. 'To Towton Crecy was but sport,
Poitiers but a pageant vain,
And the work of Agincourt
Only like a tournament.'

Give a very brief account, with dates, of the four battles named here.

2. What questions affecting the validity of their marriages were raised in the cases of Edward IV. and of Henry VIII.?
3. What do you understand of religious (*a*) toleration, (*b*) equality, and (*c*) ascendancy? Illustrate your answer by reference to ecclesiastical arrangements existing in different parts of the British Empire.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Burglary.*

Write, in small hand, as a specimen of copy-setting, '*Now, Warwick, tell me, is Edward your true king?*'

Composition.

Write an essay on the Pyramids of Egypt.

Euclid.

[The only abbreviations admitted for 'the square on AB' is 'sq. on AB;' and for 'the rectangle contained by AB and CD,' 'rect. AB, CD.']

1. Why cannot we demonstrate Prop. 4, Book 2, thus:—Let AB$=a$, and let it be divided into any parts at C; let AC $=x$, BC$=y$. Then $a=x+y$; $\therefore$ (squaring) $a^2=x^2+y^2+2xy$; $\therefore$ if a straight line, etc.
2. If a straight line be divided into two equal, and also into two unequal parts, the squares on the two unequal parts are together double of the square on half the line, and of the square on the line between the points of section.
3. In every triangle the square on the side subtending either of the acute angles is less than the squares on the sides containing that angle by twice the rectangle contained by either of these sides, and the straight line intercepted between the acute angle and the perpendicular let fall upon it from the opposite angle.

Algebra.

1. Find the G. C. M. of
$$3x^4-x^2y^2-2y^4 \text{ and } 10x^4+15x^3y-10x^2y^2-15xy^3.$$
2. Simplify $\frac{2}{a-2}-\frac{1}{2+a}-\frac{a+6}{a^2+4}$ and $\frac{(a^2-1)(a^6-1)}{(a+1)^3(a^2-a)^2}$.
3. Solve the equations—

(1) $\begin{cases} 8x+9y=1250, \\ 13y-17x+279=0. \end{cases}$

(2) $\frac{1}{2}(x-1)(x-2)=(x-2\frac{2}{3})(x-1\frac{3}{4})$.

Mensuration.

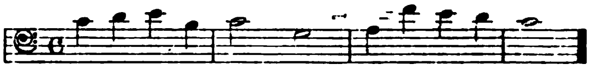
1. Find the rent of a square field whose diagonal is 7 chains 15 links at 45s. per acre.
2. How many poles are there in the circumference of a circular plot of ground whose diameter is 42 yards?

Music.

A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of F♯ (*Fe*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.
2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms:—

3. Write the following, at the same pitch, on the treble stave:—



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. £$4\frac{1}{2}$ would be gained in 1 year by £100;

$\therefore$ £24·4375 ,, $\cdot 41\dot{6}$ yr. by £$100 \times$ £$\frac{24\cdot4375}{4\cdot5} \times \frac{900}{375}$,

i.e. £$100 \times \frac{24\cdot4375}{4\cdot5} \times \frac{12}{5}$,

i.e. £1303, 6s. 8d. Ans.

2. Prime cost of 1 yd. $=$ £$138\frac{2}{3} \times \frac{1}{104} \times \frac{10}{9}$;

$\therefore$ price of 1 yd. to gain 8 p. c. $=$ £$138\frac{2}{3} \times \frac{1}{104} \times \frac{10}{9} \times \frac{108}{100}$,

,, ,, ,, $=$ £$\frac{416 \times 1 \times 10 \times 108}{3 \times 104 \times 9 \times 100}$,

,, ,, ,, $=$ £1, 12s. Ans.

3.

	£
A's debt,	$256\frac{1}{3}$
B's ,,	$203\frac{1}{2}$
C's ,,	$141\frac{2}{3}$
Total debts,	£$601\frac{1}{2}$

$$\therefore \text{ A gets } \frac{256\frac{1}{3}}{601\frac{1}{2}} \text{ of } £421\frac{1}{20} = £\frac{8421}{20} \times \frac{1538}{3609}$$
$$= £179,\ 8s.\ 8d.$$
$$\text{B gets } \frac{203\frac{1}{2}}{601\frac{1}{2}} \text{ of } £421\frac{1}{20} = £\frac{8421}{20} \times \frac{407}{1203}$$
$$= £142,\ 9s.$$
$$\text{C gets } \frac{141\frac{2}{3}}{601\frac{1}{2}} \text{ of } £421\frac{1}{20} = £\frac{8421}{20} \times \frac{850}{3609}$$
$$= £99,\ 3s.\ 4d.\ \text{Ans.}$$

4. The half-yearly dividend on £96 is 30s.
But after paying 7d. in the £, this half-yearly dividend

$$= £\frac{30 \times 233}{4800};$$

$\therefore £\frac{30 \times 233}{4800}$ is the half-yearly interest on £96,

and £$77\frac{2}{3}$,, ,, ,, $£96 \times \frac{233}{3} \times \frac{4800}{30 \times 233}$;
,, ,, ,, ,, $£96 \times \frac{160}{3}$,
,, ,, ,, ,, £5120. Ans.

5.
$$1^3 = 1$$
$$2^3 = 8$$
$$3^3 = 27$$
$$4^3 = 64$$
$$\overline{100} \text{ shares.}$$

$\therefore \frac{1}{100}$ of £350 = £3, 10s. 1st share,
$\frac{8}{100}$,, = £28, 2d ,,
$\frac{27}{100}$,, = £94, 10s. 3d ,,
$\frac{64}{100}$,, = £224, 4th ,,

FEMALES.

1. $7 \times 7 \times 27 \times 81 = 107163$ yds.;

$\therefore$ cost of 107163 at $1\frac{1}{2}$ guineas for 3 yds. $= £\frac{107163 \times 31\frac{1}{2}}{3 \times 20}$,
,, ,, ,, ,, = £56,260, 11s. 6d. Ans.

2. Time required $= 5 \text{ days} \times \frac{252 \times 420 \times 5 \times 3}{22 \times 210 \times 3 \times 2}$,
,, $= 5 \text{ days} \times \frac{63 \times 2 \times 5 \times 1}{11 \times 1 \times 1 \times 1}$,
,, $= \frac{3150}{11}$ days.
11 hrs. = 1 day; $\therefore$,, = 286 days 4 hrs. Ans.

3. Interest on £98, 15s. 10d. for $\frac{1}{2}$ yr. at $2\frac{1}{2}$ p.c.
= £98, 15s. 10d. $\times \frac{1}{2} \times \frac{5}{200}$,
,, ,, ,, ,, = £98, 15s. 10d. $\div 80$,
,, ,, ,, ,, = £1, 4s. $8\frac{3}{8}$d.

4. Prime cost of 120s. worth = 100s.,
,, 1s. ,, $= \frac{100}{120}$s.,
,, 12s. ,, $= 12 \times \frac{100}{120}$,
,, ,, ,, = 10s. Ans.

Grammar.

1. (*a*) *Courtesy* (F.), *rich* (F.), *differs* (L.), *gracefully* (F.), *remembers* (L.), *rights* (L.), *insists* (L.), *discern* (L.), *special* (L.), *connection* (L.), *human* (L.), *nature* (L.), *due* (F.).

Differs is derived from *dis*, asunder, and *ferre*, to carry.
Gracefully is derived from *grâce*, favour, and *fully* (Saxon affix).
Remembers is derived from *re*, again, and *memor*, mindful.
Rights is derived from *rectus*, straight.
Insists is derived from *in*, upon, and *sistere*, to stand.

(*b*) *Shall*—verb, defective, conj. *shall*, *should*, indic. mood, pres. indef. tense, 3d pers. sing. agr. with subj. *courtesy*.
(to) *be done*—trans. verb, strong conj. *do*, *did*, *done*, pass. voice, infin. mood, pres. indef. tense.
if—conditional conj. gov. subordinate clause (*it differ*, etc.).
at all—adverbial phrase, modifying *differ*.
others—indef. pron. 3d pers. plu. num. com. gender, obj. case, gov. by *of*.
insists—intrans. verb (but with *on* trans.), weak conj. indic. mood, pres. indef. tense, 3d pers. sing. agr. with subj. (*it*).
that—conj. introducing noun-clause (*it lies in human*, etc.).
itself—emphatic pron. neut. gen. obj. in apposition with *nature*.
due—adjective, predicative, qualifying *it*.

(*c*)

Sentence.	Subject and Enlargement.	Predicate.	Object and Enlargement.	Extensions.
(*a*) In good breeding I discern no special connection with wealth or birth. (*Principal.*)	I	discern	no special connection with wealth or birth	in good breeding (*place*).
(*b*) Which differs from high breeding only. (*Adjective qual.* 'breeding.')	which	differs from	high breeding	only (*concession*).
(*c*) If (it differ) at all (from high breeding). (*Adverbial of condition.*)	(if) it	(differ from)	(high breeding)	at all (*degree*).
(*d*) As it gracefully remembers the rights of others rather. (*Adverbial of comparison.*)	(as) it	remembers	the rights of others	gracefully (*manner*) rather (*degree*).
(*e*) Than it gracefully insists on its own rights. (*Adverbial comparison.*)	(than) it	insists on	its own rights	gracefully (*manner*).

2. The original possessive of *it* was *his* or *her*; as, 'Learning hath *his* infancy when *it* is but beginning.' 'If the salt have lost *his* savour.' 'The fruit-tree yielding fruit after *his* kind.' 'The tree of life, which yielded *her* fruit every season.'

Geography.

1. THE GREAT RIVERS OF SOUTH AMERICA.

(1) (*a*) The *Amazon*.—Its main feeder, the Marañon, rises in the Andes in Peru, about sixty miles from the Pacific. It issues from a lake in the table-land of Pasco, at an elevation of 14,000 feet. (*b*) The union of the Marañon and Ucayali forms the Amazon, which then flows to the east. (*c*) The mouth of the Amazon is 180 miles wide, and its total length is about 4700 miles. Its basin embraces an area of 2,500,000 square miles. It is more than twice the length of the Volga, and includes four times the area of basin. (*d*) The vast extent of country through which it passes is almost in a state of nature, being mostly covered with immense forests, affording shelter to wild beasts and countless reptiles.

(2) (*a*) The *Rio de la Plata* is formed by the junction of the *Parana* and *Uruguay*. The former rises in the table-land of Brazil, about 120 miles from the Atlantic, and is joined by the *Paraguay*, which rises in Brazil about fourteen degrees south latitude. The Uruguay rises in the east of Brazil, about 75 miles from the Atlantic. (*b*) The river formed by these main streams is merely a broad estuary. The general direction of its branches is south. (*c*) Reckoning from the source of the Paraguay, the total length of the La Plata is 2450 miles, somewhat longer than the Volga; and the basin is estimated at 1,250,000 square miles, twice the size of that of the Volga. (*d*) The two important rivers which go to form the Rio de la Plata from their junction, flow through the extensive grass-covered prairies called the *Pampas*. Above the confluence the Paraguay flows along the most northern part of the plains, which is known as the El Gran Chaco, the southern portion of which is a complete desert for want of rain and water.

2. The Indian Ocean is separated from the Pacific by Australia and the Asiatic Archipelago, and from the Atlantic by Africa.

It extends from the southern coasts of Asia on the north to the Antarctic Circle on the south.

This ocean is estimated to cover 29 millions of square miles.

Properly speaking, it is a double bay of very large size which forces its way up into the land by the two smaller bays of Arabia and Bengal, and still farther by the narrow inlets of the Red Sea and the Persian Gulf. The Indian Ocean is comparatively free from islands, for with the exception of the Malay Archipelago, the islands on the east of Africa are alone worthy of mention; and the largest of these is Madagascar. It contains also several coral reefs. But the most striking feature lies in its periodical winds, called monsoons, which take the place of the trade-winds of the Atlantic and Pacific, are of great value to navigation, and have a great effect on the climate of India.

History.

1. The battle of *Towton*, during the Wars of the Roses, was fought in March 1461, when Edward IV. defeated the Lancastrians, and with great slaughter, as quarter had been forbidden.

At the *Crecy* in France, in 1346, Edward III. totally defeated Philip of Valois. In this battle Edward, Prince of Wales, greatly distinguished himself. Ten years after this (1356), the same Prince of Wales, known as the Black Prince, encountered the army of John the Good at *Poitiers;* and though the English were fewer than the enemy, yet the French were overthrown, and the king was taken prisoner.

At *Agincourt* in Picardy, in 1415, Henry V. defeated an immense French army.

2. Shaw, a preacher, proclaimed in a sermon that as Edward IV. had been under a pre-contract to marry another before he married Elizabeth Woodville, his marriage with the latter was invalid, and thus the claim of Edward V. to the throne should be set aside.

Henry VIII. raised the question of the validity of his marriage with Catherine of Aragon, his brother's widow. This question was raised merely to get a divorce in order to be free to marry Anne Boleyn.

3. By religious *toleration*, which is permitted in every part of the British Empire, is meant the freedom of every religious sect to worship according to its own forms.

By religious *equality* is meant the equal enjoyment of all civil rights and offices. The former are enjoyed by all sects of religion, the latter are not open to all without exception, as, for example, the offices of Prime Minister and of Lord-Lieutenant of Ireland must be held by Protestants.

By religious *ascendancy* is understood the pre-eminence of one sect over others in a country. For example, Presbyterians have the ascendancy in Scotland, Episcopalians in England.

Composition.

THE PYRAMIDS OF EGYPT.

The pyramids of Egypt are buildings resting on a square base, and gradually tapering to a point, each of the four sides or faces bounded by an isosceles triangle. Their total number amounts to about seventy, the most of which are situated along the Libyan ridge from below Cairo to the Fayoum district. The largest are found at Ghizeh, and have attracted the attention of writers of every age; but minute investigations of their structure and the purpose for which they were built date from the time of Bonaparte.

The pyramid was probably built in courses or stages, each receding within the lower and regularly diminishing to the top, thus presenting on each side a series of rude steps, every one of which is smaller than the one on which it rests, the height of these steps likewise diminishing as they ascend. The stones are cut and fitted to each other with great exactness, and cemented with mortar, differing from all modern ones in being composed not of *carbonate* but *sulphate* of lime.

It is sufficient to state that the Great Pyramid covers an area of 13½ acres, and rises to a perpendicular height of 460 feet, but must have been 20 feet higher when entire. Its four faces look towards the four cardinal points of the horizon.

For what purpose they were built has long puzzled the curious. The prevailing opinion has been that they were erected for the one purpose of commemorating certain kings. A few years ago it was pretty satisfactorily established that the Great Pyramid, at least, was built for something connected with science and weights and measures. Professor Smyth, Astronomer-Royal for Scotland, spent some time in the investigation of the truth of the theory, and not only confirmed it, but extended the Great Pyramid standards from line and weight to heat, angle, and time.

Euclid.

1. Since the subject of geometry is *magnitude*, not number, therefore it would be a departure from strict reasoning on space to substitute in geometrical demonstrations the arithmetical or algebraical representation of a rectangle for the rectangle itself.
2. Prop. 9, Book 2.
3. Prop. 13, Book 2.

Algebra.

1. $$\frac{3x^4-x^2y^2-2y^4}{10x^4+15x^3y-10x^2y^2-15xy^3}$$
$$=\frac{(3x^2+2y^2)(x^2-y^2)}{10x^2(x^2-y^2)+15xy(x^2-y^2)}=\frac{(3x^2+2y^2)(x^2-y^2)}{(10x^2+15xy)(x^2-y^2)}:$$
$\therefore$ G. C. M. is x^2-y^2. Ans.

2. (a) $$\frac{a}{a-2}-\frac{1}{a+2}-\frac{a+6}{a^2+4}=\frac{2a+4-a+2}{a^2-4}-\frac{a+6}{a^2+4}$$
$$=\frac{a+6}{a^2-4}-\frac{a+6}{a^2+4}$$
$$=\frac{a^3+6a^2+4a+24-(a^3+6a^2-4a-24)}{(a^2-4)(a^2+4)}$$
$$=\frac{8(a+6)}{a^4+16}.\text{ Ans.}$$

(b) $$\frac{(a^2-1)(a^6-1)}{(a+1)^2(a^2-a)^2}=\frac{(a-1)(a+1)(a^3+1)(a^3-1)}{(a+1)(a+1)(a-1)(a-1)a^2}$$
$$=\frac{(a-1)(a+1)(a+1)(a^2-a+1)(a-1)(a^2+a+1)}{(a+1)(a+1)(a-1)(a-1)a^2}$$
$$=\frac{(a^2-a+1)(a^2+a+1)}{a^2}$$
$$=\frac{a^4+a^2+1}{a^2}$$
$$=a^2+1+\frac{1}{a^2}.\text{ Ans.}$$

3. (1) $8x+9y=1250$, or $136x+153y=21250$
$17x-13y=279$, or $136x-104y=2232$

Subtracting, $257y=19018$
$y=74$. Ans.
$\therefore x=73$. Ans.

(2) $$\frac{(x-1)(x-2)}{2}=\left(\frac{3x-8}{3}\right)\left(\frac{4x-7}{4}\right)$$
$$\frac{x^2-3x+2}{2}=\frac{12x^2-53x+56}{12},$$
$$6x^2-18x+12=12x^2-53x+56.$$
Transposing, $6x^2-12x^2-18x+53x=56-12.$
Collecting and changing signs, $6x^2-35x=-44.$
Dividing by 6, $x^2-\frac{35x}{6}=-\frac{44}{6}.$
Completing square, $\left(x-\frac{35}{12}\right)^2=\frac{1225}{144}-\frac{44}{6}$ or $\frac{1056}{144}.$
$$\left(x-\frac{35}{12}\right)^2=\frac{169}{144}.$$
Taking the root, $x-\frac{35}{12}=\pm\frac{13}{12},$
$$x=\frac{35}{12}\pm\frac{13}{12},$$
$x=4$ or $1\frac{5}{6}$. Ans.

Mensuration.

1. Area of square $=\frac{\text{square of diagonal}}{2}=\frac{715\times 715}{2}$ links
$=\frac{511225}{2}=255612\cdot5$ square links $=2\cdot556125$ acres at 45s.

```
  2·556125
        45
 ---------
  12780625
 10224500
 ---------
115·025625s.
        12
 ---------
   ·307500d.
         4
 ---------
  1·230000 farthings.
```

$\therefore$ the rent $=$ £5, 15s. 0¼d.

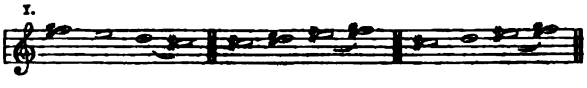
2. Circumference = diameter $\times 3\frac{1}{7}$;

$\therefore$ circumference $= 42$ yards $\times 3\frac{1}{7} = \frac{42 \times 22}{7}$ yards

$= 132$ yards $= \frac{132}{5\frac{1}{2}}$ poles $= 24$ poles. Ans.

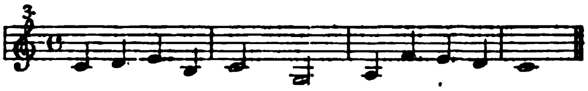
Music.

1.



2.

3.



Engagements for June.

June 2.	Linnean Society,	8 p.m.
	The Royal Archæological Institute,	4 p.m.
	Church School and S. Benevolent Institution Annual Picnic.	
	East Kent District Union Annual Meeting.	
3.	Royal Institution, Professor W. G. Adams, 'Magnetic Disturbance, Auroræ, and Earth Currents,'	8 p.m.
	Philological Society, Henry Sweet, M.A., Vice-President, 'On Some Points in English Grammar,'	8 p.m.
	Carlyle Club (Bridge House Hotel),	8 p.m.
6.	Exam. London University.	
7.	Society of Biblical Archæology,	8 p.m.
8.	Geological Society,	8 p.m.
10.	Royal Institution, Professor Dewar, M.A., F.R.S., M.R.I., 'Origin and Identity of Spectra,'	8 p.m.
	Royal Astronomical Society,	8 p.m.
	New Shakespeare Society, — Poole, Esq., 'On the Alterations in the Acting Editions of Shakespeare's Plays,'	8 p.m.
	Cheltenham College Reunion.	
13.	Geographical Society,	8.30 ,,
14.	Anthropological Institute,	8 p.m.
16.	Linnean Society,	8 p.m.
17.	Philological Society, Herbert M. Baynes, Esq., 'The Psychological Method in its Application to Language,'	8 p.m.
18.	Stafford District Union.	
	Inaugural St. Mary's Girls' School, Lichfield. Mr. Rankilor will address the meeting,	1.30 ,,
20.	Victoria Institute, Rev. H. G. Tomkins, 'Biblical Proper Names, Personal and Local, illustrated from Sources external to Holy Scripture,'	8 p.m.
	Matric. Exam. London University.	
22.	Geological Society,	8 p.m.
24.	Battersea College Anniversary.	
27.	Geographical Society,	8.30 ,,
28.	Anthropological Institute,	8 p.m.
30.	Saltley and York Colleges Vacation commences.	

Publications Reviewed.

London Geographical Readers. Book III. for Standard IV. By Charlotte M. Mason. Post 8vo, 316 pp. Price 2s. 3d. London: Edward Stanford.

This is one of the many books called into existence by the now well-known Art. 19, C. 1. In many respects it is unlike any of its rivals, and ought, we feel sure, to take a high rank amongst them. To the scores and scores of friends who from time to time have asked us to recommend a manual which in a brief form presents full and reliable information of the English counties, we say here is the very book. We are mistaken if this entertaining volume has but an ephemeral sale; it deserves a permanent place among standard geographical literature.

The style is highly attractive; indeed, the book reads like a tale. Thirty-six valuable maps enrich its pages.

Payne's Studies in English Literature. Prose and Poetry. Crown 8vo, 960 pp. Price 7s. 6d. London: Crosby Lockwood & Co.

As we turned over the pages of this goodly volume, it was a pleasure to renew old friendships, to shake hands, so to speak, with the men and women who have enriched our mother tongue with their prolific pens.

The selections are admirable, and the whole work one of surpassing merit. So far as we know, there is no kindred work fit to be compared to it. The carefully-written footnotes will prove invaluable to all who use the book.

Self-Culture for All. Part VII. Price 6d. London: Ward, Lock, & Co.

This capital serial has reached its seventh part, which in point of excellence is equal to its predecessors.

Chambers's Geographical Readers. Book II. for Standard III. Fcp. 8vo, 128 pp. Price 10d. London: W. & R. Chambers.

We are much pleased with this cheap unpretending-looking volume designed to meet the requirements of the new article in Geography. Many teachers will thank Mr. Meiklejohn for his little book, whose crowning merit is its *extreme simplicity*. Any child in the Third Standard will read it fluently. We dwell upon this excellence because the language in many of the Geographical Readers already put forth is far too hard. We are, however, sorry to see a host of useless so-called test questions occupying space which could have been turned to better account. The book is embellished with a series of excellent illustrations—illustrations that, we venture to say, will be equally helpful to the teachers as to the scholars. The printing and binding has been done in the Messrs. Chambers's usual commendable style.

Marcus Ward's Arithmetic. By J. W. Marshall. In Three Parts. London: Marcus Ward & Co.

When we opened this book we own to being rather prejudiced in its favour. The tasteful design and imprint on the cover, the excellence of the paper and printing, and the rare clearness of the bold round

type, together with the neat and judicious arrangement of the text, must be our explanation for this prejudice. In these points the book has never been excelled. It is a pleasure to look at it. The writer of the book is no novice: the practised hand of a skilful teacher is shown on every page. A full and simple explanation of each rule is given. The exercises are numerous, well graduated, and include an excellent selection of problems. The higher Standard work is hardly 'stiff' enough—that is, if we keep in view the ever-varying standards set up by H.M. Inspectors. Assuming the answers (which have not been received by us) to be correct, we strongly recommend Marcus Ward's Arithmetic.

The Child's Geography. By M. J. Barrington Ward, M.A. 60 pp. Price 6d. London: Marcus Ward & Co.

As an Inspector of Schools, Mr. Barrington Ward is so conscientious and thoroughly imbued with the love of his work that we are pleased to see his 'Child's Geography.' In an unassuming preface he states that his object in issuing his booklet is to simplify his subject and render it more interesting to the little ones. In this twofold object he has succeeded in a marked degree. The language is at once simple and natural, and quite free from that childishness which too often disfigures books penned expressly for young people.

The excellent illustrations which appear (with one exception) at every opening of the text are appropriate, and lend an additional charm to the work. We regret, however, to find a series of questions tacked on to each page. This is a mistake—a grave one. Good teachers don't need them, and lazy ones should certainly not have them placed at their fingers' ends. It seems to us a pity that this valuable space should be thus wasted. Still the work is a long way ahead of any *introductory* school Geography designed for *young* beginners that it has been our privilege to examine. The cheery little folk who receive their education at home, and who have hitherto spelt their way through the horrid dry question and answer book, will hail its advent with delight. Messrs. Marcus Ward & Co.'s name is a sufficient guarantee that the paper, printing, and binding are all that could be desired for the modest sixpence at which the book is published.

New Testament, Revised Version. 496 pp. cr. 8vo. London: Oxford and Cambridge Warehouses.

We received this volume just as we were going to press. We cannot, therefore, at present, do more than simply announce its publication. The edition with which we have been favoured is well printed in large type (Longprimer) on good paper. The binding is neat and durable.

Class-Book of Elementary Mechanics: An Introduction to Natural Philosophy. Part I., Matter. By William Hewitt, B.Sc. 87 pp. London: George Philip. 1880.

The first and most difficult point to decide with reference to a book on Natural Philosophy, is whether it has the slightest pretence of an excuse for coming into existence at all. When the market is flooded with such, when small men and great men alike have had their say on this subject, it might almost be supposed that it is exhausted. Mr. Hewitt, however, thinks differently. He shall defend himself. 'Some three years ago,' he says, 'the Liverpool School Board resolved to introduce experimental science teaching into their schools, and the writer was appointed to organize a scheme of demonstrations in accordance with this resolution. The subject selected for demonstration in the boys' schools was Elementary Natural Philosophy, or Mechanics, as defined in Schedule IV. of the Revised Code. . . . The difficulty hitherto has been to get the children to express in anything like precise language the ideas which the experiments have suggested to their minds. It is hoped that a careful reading of the following lessons,' etc. The justification is, we think, sufficient; and having now got a plan of the whole work in our minds, we will proceed to consider the details. It is divided into thirty-four lessons, each of which should, always supposing the teacher to assist with diagrams and experiments, take an average class about an hour. There are about half a dozen exercises at the end of each lesson, and a hundred miscellaneous examples at the end.

The exercises are a very praiseworthy part of Mr. Hewitt's work. They must inevitably lead the children to think for themselves. Common incidents, which through their very commonness are deemed insignificant, are here made the vehicle of most important instruction. Take a few examples:—

'When a glass stopper is fast in the neck of a bottle, people sometimes slightly warm the bottle neck, and the stopper comes out easily. Explain this.'

'If the upper portion of the spout of a kettle were cut off, to what height could the kettle be filled with water?'

'People sometimes water plants in flower-pots by letting the pot stand in a saucer of water. Describe and explain the manner in which the water gets to the roots of the plant, and even to the top of the soil.'

'If a dry towel or handkerchief be placed in a basin of water with one end hanging over the side, the water will drop from this end provided it is lower than the surface of the water in the basin. Explain (1) why the material becomes wet at all, and (2) the continual dropping of water from the end outside.'

Simple as these things are, they are yet amply sufficient bases for lectures on expansion, fluid levels, capillarity, and the siphon. The teacher might talk learnedly for hours on the reason of capillarity, and the open-mouthed youngsters, as probably as not, would imagine capillarity was a sort of medicine. But let him take any simple example, bread-crumbs sucking up moisture, flower-pots, or anything, and capillarity would vanish from the Materia Medica to take its place among reasonable phenomena which boys might attempt to understand.

We have said enough on the merits of Mr. Hewitt's work. It is exactly adapted to those for whom it is intended. Yet we have one little bone to pick. Should not absurd inaccuracy in the choice of titles be left to novelists? The ordinary rule of the present day to guide the luckless creature who has written a novel in the choice of a title, is to mix letters in a bag, or after the fashion at Laputa, and take the first set that turns out, respecting it only if it is all consonants. Mr. Hewitt has not quite followed this, but

neither is he altogether original in his method of choice, for it is perfectly certain that three-quarters of the lessons with which we have been dealing have not the remotest possible connection with Mechanics, the science of *Machines*. Indeed, if they had had such a connection, it seems as likely as not that Mr. Hewitt would have called his book Philology or Chemistry.

Mechanics for Junior Students, including Hydrostatics and Pneumatics. By W. J. Browne, M.A. (Lond.), Inspector of National Schools, Ireland. 5th ed. 178 pp. Price 2s. Manchester: John Heywood.

We have next to consider another book on Mechanics, and we are bound to confess at the outset, that Mr. Browne has not succeeded so well in his object as Mr. Hewitt in his. The two books are in a measure complementary, but yet Mr. Browne by no means fills up Mr. Hewitt's deficiencies, and to fill up Mr. Browne's would almost certainly be a task from which Mr. Hewitt would beg to be excused. The one book explains theories by common-sense examples, the other scorns common sense, and proceeds to mathematical demonstrations. We have no great inaccuracies to lay to Mr. Browne's charge; in fact, we have noticed no mistakes, and only one or two misprints not at all important. The chief fault we have to find with the book is its inextricable confusion. Statics, Dynamics, and fragments of Machines are mixed together with lamentable carelessness. From considering Energy and Work, most indisputably dynamical ideas, we are roughly introduced to Friction, which, as far as it is here treated, has a fair right to claim affinity with Statics. But our path is by no means to lie through Statics for the rest of the journey. Scarcely, in fact, have we been introduced to Friction, when we fly off at an abrupt tangent to Impact. And thus, by a wriggling, jerky method, we reach our goal and the welcome end, by no means quite certain that we have not gained a smattering of every science under the sun that has the remotest connection with Mechanics.

There is the same capriciousness in the choice of phenomena that are dignified with an explanation as there is in the arrangement. Capillarity, one of the hardest problems in Hydromechanics, receives half a page and a diagram; while the application of Resolution of Forces to the solution of simple statical problems other than the ordinary run of pulleys, inclined planes, and cranks, is scarcely mentioned.

And then, again, we object to the identification of the Principle of Energy and Virtual Velocities. There is no doubt that Virtual Velocities is *Virtual* Work, but the omission of the adjective makes all the difference. Virtual work and work are not the same, although the one is a particular case of the other, any more than the science of Infinitesimals is a part of Algebra. To apply the Principle of Work, a very ordinary amount of common sense is all that is necessary; but to apply Virtual Work, the Differential Calculus is as often as not quite indispensable—in other words, Work, or Energy, belongs to the domain of Kinematics; Virtual Work, to that of Analytical Statics.

Friction, again, is a theory which, as Mr. Browne presents it, is utterly valueless in practice. It is surely as important to state this as it is to give an empirical formula for the velocity of a shot on leaving a cannon.

But we must have done with our complaints. On the whole, Mr. Browne's book has very many good points. He is peculiarly happy when he gets among Machines, and once there he has the good sense to remain there as long as possible. Five editions have greatly improved the work. We have shown that there is room for further improvement. For the author's sake, let us hope that there is room in the world for another edition.

In conclusion, we will remark that Matriculation Candidates would be greatly benefited by it.

Primer of the Industrial Geography of France. By G. P. Bevan. London: Sonnenschein & Allen.

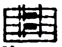
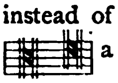
This so-called primer merits the name of a text-book of the subject on which it treats. The various productions, manufactures, and commercial features of France are not merely enumerated, but described with care and accuracy. Boys and girls will readily follow the agreeable and lucid reasoning which these pages gently associate with the descriptive process. The description, too, is very much more valuable than the bare enumeration of facts to which many geographical books are confined. A capital summary is also given under the heading of a table of **Industries**, in which the product or manufacture is given with the name of the place where carried on. The book is admirably printed, and contains also a succinct and useful table of English equivalents of ordinary French money, weights, and measures. Young readers will find this primer pleasant reading, and finish it with a very different and much superior knowledge of the nature of the leading industrial features of France than from the bare and vague ideas conveyed by many more pretentious books.

The Notation of Vocal Music. By W. W. Pearson. London: Reeves & Novello.

This tract is an attempt to simplify musical notation in the avoidance of key signatures by *Substitution of Pitch*, and thus applies the *principle* of the 'Tonic Sol-Fa system' to the ordinary or established notation. This *principle* indeed is not peculiar to the method or system developed by Mr. Curwen from Miss Glover's idea, as it was in ancient, and we may say general, use till the mistake was made of attempting to establish the Wilhelm or *Fixed Do* system under the Shuttleworth-Hullah effort in 1840. In Lancashire, vocalization was taught under the 'Moveable Do' system; and the same method was developed in a class-book written by the late John Turner, Esq., and published by the Christian Knowledge Society, about the time that Dr. Hullah's adaptation of Wilhelm's method first appeared. Mr. Pearson hits the blot on this 'Moveable Do' nomenclature by the necessity of change of name which this system involves. As 'every note will have seven different names according to the key in which it appears,' the pupil, Mr. Pearson observes, 'will be some time before he makes much progress.'

Without pausing to notice the way in which Balfe Crampton, and the practical drillers of opera singers have cut this knot by the avoidance of the Sol-Fa

syllables altogether, we proceed to mention that Mr. Pearson proposes to render the Natural Key available for music in every key by a plain and simple indication of the (absolute) pitch required, similar in fact to that used by the Sol-Faists. No one can doubt but the path of the learner would be immensely smoothed by this plan, which Mr. Pearson clearly explains. In addition to his explanatory remarks, he also gives a few well-known specimens by way of illustration. Among these is Weldon's *O Praise God*, which also serves to show the simplification of time recommended by Mr. Pearson. This latter proposal involves no serious change, but merely the application of the Crotchet Notation to all kinds of time. To this there can be no more valid objection than to the abandonment of the old *longs* and *breves*. The words used to indicate time movement are sufficiently explicit to justify this attempt to lessen a superfluous nomenclature. In this Mr. Pearson would eliminate $\frac{3}{2}$ and $\frac{3}{8}$ signatures, and for both these use $\frac{3}{4}$ with a suitable term of time movement. With *allegro* or *vivace* $\frac{3}{4}$ meets all the requirements of $\frac{3}{8}$ signature, and with *adagio* or *lento* that of $\frac{3}{2}$, which some regard as essential to ecclesiastical music.

Mr. Pearson recommends the disuse of the Tenor clef with greater diffidence. Yet we are glad to see that he does discountenance this stumbling-block in the path of music which public convenience will no longer tolerate. Part music with the Tenor clef has now very little chance of sale. Even the cautionary 'octave lower' is now generally omitted, and the word TENOR considered quite sufficient to indicate the practical applicability of the Treble clef to Tenor music. Those, however, who admire this fetish sign may have their taste gratified, while the advocates of simplicity may also be satisfied by the placing of the Tenor clef sign across the third space thus:  instead of across either the third or the fourth line:  a plan now often adopted in this country, and very generally in America. In recommending the use of C key (the natural key) for all vocal music, Mr. Pearson aptly illustrates his object by the use of crooks for the French horn, in which, by a crook for every key, all music is *read* from the key of C. By these remarks Mr. Pearson's aim in the direction of simplicity and utility will doubtless be gathered, in addition to which it is no new nomenclature nor novel notation that he recommends, but merely the application of the established notation to the excision of needless difficulties. 'Let the teacher of elementary singing,' says Mr. Pearson, 'confine his instruction and the practice of his pupils to the key of C, the treble clef, and the crotchet notation, transposing all music otherwise written into these, and I will venture to say that the results will surpass his most sanguine expectations.'

With all this we cordially agree. Nothing can be lost thereby. No step has to be taken that has afterwards to be retraced. Nothing has to be learnt that is afterwards to be unlearnt. Even if the study of keys be hereafter desirable, this preliminary and thorough knowledge of the key of C will facilitate the knowledge of the secondary steps. Doubtless the work of transposition from another to the key of C will greatly aid the knowledge of the use of keys, and a prolonged practice in the key of C also be the best introduction to music in other keys, which, by Mr. Pearson's method, would be needless so far as vocal music is concerned.

The Bicycle Road Book. By Charles Spencer. 219 pp. cr. 8vo. Price 2s. London: Griffith & Farran.

Now that the summer-time is here, and with it the holiday season, tourists are already on the alert planning their 'outings.' To the bicyclist who has not yet made up his mind where to go, we strongly recommend the new edition of Mr. Spencer's valuable road book. In it he will find everything likely to contribute to the enjoyment of his trip. The book is cheap, well bound, printed in clear readable type, and has our best wishes for its success.

Byron's Siege of Corinth, and Wordsworth's Ode to Duty. Price 2d each. London: W. & R. Chambers.

Every teacher must surely know Chambers' reprints of the English classics. Concerning the above two books, the best testimony we can bear is to say they are in all respects fully equal to their worthy predecessors in the same series.

Shakespeare's Midsummer Night's Dream. Edited by Rev. C. E. Moberly. (London: Rivingtons.)

This clearly-printed, carefully-edited handy little volume will prove of great service to those who are reading Shakespeare's *Midsummer Night's Dream.*

Geography for the Use of Schools, designed to assist Candidates preparing for Army, Civil Service, and other Examinations. By W. M. Lupton. London: Longman & Co.

This compendium of geographical facts will be very useful as a book of reference to text-books and other explanatory treatises on Geography, and is intended by its author to be accompanied by his Geographical Questions. Taken alone, it is *not* a book for schools in which the science of Geography is now being wisely associated with reading lessons. Schoolboys, in fact, need the descriptive and instructive features of Geography to be enlarged instead of being diminished; and although we cannot divest our school-books of method and arrangement which are delightfully absent from books of travel and gossiping rambles, yet we believe that geographical facts are better and certainly far more pleasantly acquired by lively and interesting narrative than by a bare enumeration of facts and names. This remark must not be understood as an objection to Mr. Lupton's book, but to its being used injudiciously. As a compendium it evinces remarkable skill in presenting the leading facts and most salient features of every country in every quarter of the globe, and almost of every place of sufficient importance to be thus mentioned. The information is brought down to the present time, to the cession of Dulcigno and Montenegro. The facts mentioned in the enumeration of the principal towns and places of note in Great Britain are particularly well chosen, and present little for objection or correction. The book is also useful in its index of nearly 4000 places, occupying nearly 23 pages. 'Sheerness, at the mouth of the Medway,' might be better stated as being at the *confluence* of the Thames and

Medway. We fear that the former prosperous oyster trade of Poole is nearly destroyed. Some forty years ago, oysters were sold in this old town at the rate of 6d. and 8d. a hundred, but now fetch prices that would drive a Dando to despair. Rochester also was associated with the oyster trade more from being the *entrepôt* of the China Rock and Queenborough fisheries than for having oyster beds of its own. Gravesend we should rather describe as a watering-place and the entrance to the port of London, than on account of its batteries, which, however, are now important. A very useful feature of Mr. Lupton's book in the enumeration of rivers, is the mention of their leading tributaries, together with the principal towns on their respective banks. The glass manufacture of Bristol should have been mentioned in connection with this city, and also that Somersetshire has as good a claim to a large portion of Bristol as Surrey has to a part of London. The mention of many places in connection with recent facts shows that Mr. Lupton is no thoughtless compiler.

Self-Education: An Essay on the Relation between the Teacher and the Taught. Price 1s. London: Guest.

Dr. Hime is an ardent believer in the good old-fashioned way of getting on in life by patient persistent plodding. His essay demonstrates that he who desires to excel may in spite of any difficulties. It denounces the pernicious system of 'cram' which is opposed to all true education, and strongly urges the student to form the habit of relying upon his own powers for success. The book should be widely read.

Johnston's Illustrations of Light and Heat. With Handbook. London: W. & A. K. Johnston.

These beautiful illustrations, accompanied as they are by a useful little handbook, will render the science lecturer great help. And nothing in their way could be better for illustrating an occasional 'object' or 'oral' lesson. The drawing and colouring are so uniformly excellent that the diagrams arrest the attention at once. They are worth buying, if only to brighten up the schoolroom and make it look more attractive.

Wonders of the World. By W. Gilbert. Price 3s. 6d. London: Strahan & Co.

This is a really capital book, one that will delight the old folk as well as the young. Mr. Gilbert has the knack of telling a sensible story in first-rate style, and is never wearisome. We heartily commend his elegantly-bound volume. As a prize, it cannot fail to give satisfaction to the lucky youngster who becomes the happy possessor of it.

Monthly Notes.

[*The Editor will have pleasure in inserting Short Notices of Association meetings. Communications should be written on one side of the paper only, and sent early in the month.*]

THE CONFERENCE ON CODE REFORM was one of the principal educational events of the last month. In consequence of the announcement of the Vice-President, that it had been resolved to introduce considerable changes in the Code, steps were taken to form an association of leading educationists, who should bestow their united consideration on the subject, and submit to the Education Department the result of such consideration. The leading part in the formation of this association was taken by Mr. Mark Wilks, chairman of the School Management Committee of the School Board for London, and the Rev. E. F. M. MacCarthy, chairman of the Education Committee of the Birmingham School Board. The result of their action was, that an association was formed, consisting of the following gentlemen:—

Rev. E. A. Abbot, D.D., Head Master of the City of London School; Rev. Wm. Barnes, Chairman of School Management Committee, Leeds School Board; Rev. J. W. Caldicott, D.D., Head Master of Bristol Grammar School; Charles Doncaster, Esq., Chairman of S. Man. Com., Sheffield School Board; H. W. Eve, Esq., Head Master of University College School, London; Professor G. Carey Foster, F.R.S., Professor of Physics, University College, London; Professor Gladstone, F.R.S., Member of the London School Board; James Hanson, Esq., Chairman of S. Man. Com., Bradford School Board; Professor Henrici, F.R.S., Professor of Applied Mathematics, University College, London; Sir U. Kay-Shuttleworth, Bart., Member of the London School Board; Rev. Brooke Lambert, Vicar of Greenwich; Sir John Lubbock, Bart., F.R.S., M.P. for the University of London; Rev. J. F. McCallan, Chairman of S. Man. Com., Nottingham School Board; Rev. E. F. M. MacCarthy, Chairman of the Education Committee, Birmingham School Board; Professor Meiklejohn, Professor of Education in the University of St. Andrews, N.B.; Richard Morris, Esq., LL.D., President of the Philological Society, London; Rev. T. D. C. Morse, Member of the London School Board; Professor Max Müller, Professor of Comparative Philology, University of Oxford; William Oulton, Esq., Chairman of S. Man. Com., Liverpool School Board; Rev. Mark Pattison, Rector of Lincoln College, Oxford; J. Allanson Picton, Esq., formerly Member of the London School Board; Rev. R. H. Quick, formerly Assistant Master at Harrow School; A. Sonnenschein, Esq., Author of *Science and Art of Arithmetic*, etc.; R. F. Weymouth, Esq., D.Lit., Head Master of Mill Hill School, Middlesex; Mark Whitwill, Esq., Chairman of the Bristol School Board; Mark Wilks, Esq., Chairman of S. Man. Com., London School Board; Rev. Joseph Wood, Chairman of the Leicester School Board; R. Wormell, Esq., D.Sc., Head Master of the Middle Class School, Cowper Street, E.C.

Considerable dissatisfaction was manifested by, and on behalf of, certificated (elementary) teachers that their co-operation was not invited. Non-members were, however, allowed to attend the Conference and to take part in the discussion, though not to vote, and several gentlemen connected with the work of elementary teaching did actually avail themselves of this privilege. The Conference met in the Board Room of the School Board for London, on Thursday the 21st April. Mr. Mark Wilks was elected to preside, and the Rev. Mr. MacCarthy to act as secretary. The chairman opened the proceedings by explaining the origin and objects of the Conference. These objects were, first, to produce a memorial to the Education Department, setting forth generally the principles of the association, and then to apply these principles to the Standards of the Code, thus to examine and determine what were the most practical and practicable Standards of instruction. It was hoped, he said, that sub-committees which had been appointed by the association would have been able to bring up a report to the meeting, including not only a draft of the memorial, but also a rough draft of the proposed alterations in the Standards, and also a revision of the Fourth Schedule. The time at their command had not been sufficient to accomplish the

whole of this purpose. The memorial, however, was prepared. He would therefore suggest that the Conference should devote the present session to the consideration of the memorial, and then adjourn, to meet on the 4th of May for the disposal of the other parts of the programme. This suggestion was unanimously adopted. The draft memorial was then discussed clause by clause, after which the Conference adjourned as agreed upon.

The adjourned Conference on Code Reform was held in the Board Room of the London School Board, on Wednesday the 4th May, Mr. Mark Wilks in the chair. After some discussion, it was moved by Mr. Wilks that the following memorial to the Education Department be adopted. This was adopted with one dissentient :—

To the President, Vice-President, and Lords of the Committee of Council on Education.

We, the undersigned, being intimately associated with Educational Work in this country, and convinced that the whole range of Education from the Elementary School to the Universities is so organically connected that the course of instruction followed in the Elementary Schools cannot but affect directly the work of the Secondary Schools, and through them, to an increasing extent, even the Universities, have long felt that the educational provisions of the existing Code fail to secure either a solid foundation for all Education, or the substantial equipment of the children passing through the public Elementary Schools for their future duties and responsibilities.

We have accordingly heard with the utmost satisfaction that your Lordships have under contemplation the making of fundamental changes in the Regulations of the Code.

We would respectfully submit—that the experience of the past has led to the acceptance of certain general Principles of Education, and that these cannot be neglected without seriously detracting from the value of the early training given at school.

The most important of these principles are—(1) That the Course of Studies should, at each stage, be in harmony with, and adapted to, the natural development of the child's mind and body. (2) That all teaching should proceed from the Known to the Unknown; from the Particular and the Concrete to the General and the Abstract; and from the Empirical to the Rational and Scientific.

We would respectfully urge that the Standards (Art. 28) and Stages (Schedule IV.) are, at different points, at variance with one or other of these principles.

We would remind your Lordships that these principles were enunciated by the Committee of Council thirty-seven years ago, and embodied in the Minutes on Methods of Teaching issued by the Committee in 1844; and we would also point out that they are recognised in a greater or less degree in the most approved Manuals of Method now in the hands of those who are being trained as Elementary Teachers.

We would therefore ask for the unreserved adoption of these principles as the basis of our Public Elementary Education.

A draft, or series of drafts, were then laid before the Conference, in which were embodied the results of the deliberations of the sub-committees appointed to consider the changes which it is desirable to introduce in the Code with reference to the Standards of Examination and the Fourth Schedule. These received careful and minute consideration from the Conference, and after considerable discussion a large number of suggestions were agreed upon, which it was resolved to present to the Department as in harmony with the general principles embodied in the memorial. The memorial, with the names of the members of the association appended, and these suggestions, have accordingly been presented to the Department. These suggestions have met with considerable approval from the principal educational journals. There is, however, a general agreement that they err in expecting and demanding an amount of work which is beyond the capacity of the children attending Elementary Schools.

BRITISH AND FOREIGN SCHOOL SOCIETY.—The seventy-sixth annual general meeting of the British and Foreign School Society was held on Monday in the Lecture Hall, Borough Road—Lord Aberdare, the President of the Society, in the chair. The report, as read by Mr. A. Bourne, B.A., the secretary, stated that the colleges were quite full, well reported of by the Government, and in a very prosperous condition educationally. Briefly sketching the work of the year, it was shown that at five sets of elementary schools 1957 children were under instruction, with an average attendance of 1501. Of those which were recognised by the Education Department as British and Board schools, there were 4871, with accommodation for 1,468,668, a roll of 1,427,949 names, and an average attendance of 1,012,264. The financial statement showed receipts to the amount of £22,470, 5s. 2d., and an expenditure of £22,445, 11s. 4d., being an excess of receipts of £24, 13s. 10d. With the addition of the money locally received and spent at Darlington, Swansea, and Bangor, the figures became—receipts, £31,063, 11s. 7d.; expenditure, £30,981, 5s. 1d.; balance, £82, 6s. 6d.

Lord Aberdare, in moving the adoption of the report and financial statement, said that in all respects the report was a satisfactory one. He also congratulated the Society on the fact that the Board Schools of this country had declared in favour of the system upon which the schools of the British and Foreign Society were instituted. Out of a thousand Boards established since the passing of the Education Act, all but forty-nine had adopted the British School system. A resolution was proposed by Dr. Gladstone, of the London School Board, congratulating the Society on the results of its operations in promoting the Kindergarten system of teaching, and expressing the hope that these operations will be continued and extended.

PRESENTATION DAY AT THE UNIVERSITY OF LONDON was held on Wednesday the 11th ult. Lord Granville, the Chancellor, presided, and the theatre was crowded with ladies and gentlemen interested in the proceedings. A remarkable feature of the proceedings consisted in the fact that this was the first time in the history of the University when degrees were conferred on women. On this occasion three ladies received certificates of matriculation, four received degrees of B.A., and one a prize for French in the First B.A. Examination. Lord Granville, in one of

those charmingly humorous speeches for which he is distinguished, thus referred to this circumstance:—He had to remark that no question had been more warmly discussed than what should be the relation of women to the University. The practice and principle of the latter had widened, and at that moment he was happy to say, so far as education was concerned, ladies could regard that University absolutely on the same footing as men. He felt sure that, however warm the controversy might have been before this decision was taken, now that the experiment was decided on, all feeling of opposition would subside, and those who really had the welfare of the University at heart would be desirous to see the success of that experiment. As far as he knew, there had been no hitch or difficulty in their proceedings, and they had had evidence that day of the way in which the ladies distinguished themselves in the examinations. No less than four ladies, two in the first and two in the second division, had that day become graduates of the University and he believed from certain signs which had been given that day, that the infusion of feminine graduates would add to the utility, as it certainly had done to the grace, of their proceedings. His Lordship also stated that after careful consideration it had been determined to extend the examinations into the science and art of teaching, for which purpose a scheme had been prepared, which would shortly be carried out. This year for the first time the University had conferred degrees for Music, which he considered a satisfactory point. He also announced that their application to the Treasury for the establishment of a practical museum of natural history to enable them to carry on examinations on their own premises had been most liberally met, and he hoped that in a very short time such a department would be opened.

TECHNICAL EDUCATION.—The foundation of the City and Guilds of London Technical College at Cowper Street, Finsbury, was laid by Prince Leopold on Tuesday the 10th ult. The Lord Chancellor and Mr. Mundella attended and took part in the proceedings. Lord Selborne, who, as chairman of the Council of the Institute, was deputed to bid his Royal Highness welcome, having performed this duty, said:—The City and Guilds of London Institute was formed a few years ago by the munificence and liberality of the Livery Companies of London, aided now, he was happy to say, by the Corporation. It was formed with a view of supplying the want to which he had referred, and liberal subscriptions had been given both for annual expenditure and building purposes. The Institute had conducted local examinations, and the readiness of working people to take advantage of them had been signally illustrated. The object of the central institution, for which an available site had been secured at a nominal rent at South Kensington, was to give the highest kinds of instruction necessary to qualify persons to become teachers of the industrial arts. This College was intended especially for the benefit of artisans. The College was not meant to teach trades, or to interfere with the necessary training of the factory and workshop, but it was intended to give them the knowledge which would enable them to receive that training in the most intelligent and effective manner; and that such an institution was appreciated by artisans had been abundantly proved. The work was already in progress. By the aid of the proprietors of the middle class schools, they had been for two or three years past carrying on in suitable class-rooms the instruction of artisans in Applied Chemistry and Applied Physics, and the appreciation and success of that instruction had been great. Another branch had been opened at Castle Street, Leicester Square, for handicrafts; but when that College was finished, the work would be transferred there. The building would contain thirty-two rooms, including a large laboratory, two lecture theatres, suitable class-rooms, workshops, engine-room; and there would be ample accommodation for the full development of the work which had to be done.

A DOMESTIC ECONOMY CONGRESS was held on the 20th May, which was attended by a large number of ladies of rank, and others. We were obliged to go to press, however, before receiving an account of the proceedings.

FREE EDUCATION (SCOTLAND) BILL.—On Wednesday the 18th May, Dr. Cameron, one of the members for Glasgow, moved the second reading of this bill. The object of the bill was to bestow absolute discretion on School Boards, if they thought proper, to give free education to the children in their districts. Colonel Barne moved the rejection of the bill. It was opposed by some members on the ground that it was in advance of public opinion, and by others because they disapproved of its principle. Mr. Mundella affirmed that the present law was working admirably, and that the adoption of this measure would rather retard than advance popular education in Scotland. The measure was eventually withdrawn.

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Query Column.

*** *Communications for this column must reach the Office not later than the 15th inst., and should be addressed,* 'THE QUERY EDITOR' of the *Practical Teacher*, Pilgrim St., Ludgate Hill, London, E.C.

We are now receiving such a number of Queries that we are obliged for the future to limit each Correspondent to one question. When more than one is sent, we shall if possible give hints for the solution of all, or solve the most difficult only. All, however, who attend to our rule may be sure of getting their question fully explained.

1. JOHN PEGG, Leicester.—The month of July 1828 was remarkable for excessive rains. At Derby the quantity collected in the pluviometer between the hours of *nine* A.M. of the 9th of that month and *six* the following morning (an interval of 21 hours) was 3·59 inches; to the evening of the 15th it amounted to $7\frac{1}{2}$ inches; and by the conclusion of the 29th (an interval of 21 days, of which 10 only were very rainy) the total depth of water collected was $11\frac{1}{4}$ inches. How many hogsheads of 54 and 63 imperial gallons respectively fall on an acre of ground to amount to the depth of one inch? and how many hogsheads of each kind fell on the surface of an acre during each of the three several periods above mentioned?

We will work the sum with the hogshead of 54 gallons so as to exhibit the method.

An acre=6,272,640 sq. inches;

∴ this same number of cubic inches cover an acre to the depth of 1 inch. But a gallon=277·274 cubic inches; ∴ in the case before us $\frac{6272640}{(277{\cdot}274)\times 54}$ hogsheads fell on an acre.

This can be easily evaluated. It is about 429.

To take now the first of the specified periods, 3·59 inches were recorded by the rain-gauge, say 3·6. This gives $3·6 \times 429$, *i.e.* about 1544 hogsheads, etc.

All the other parts are similar, but increasingly tedious.

J. P. will always find the following figures useful in such questions:—

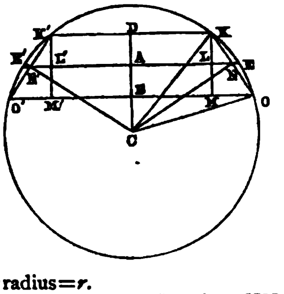
An imperial gallon contains 277·274 ($277\frac{1}{4}$) cubic inches.

A cubic foot of water weighs 997 (1000 nearly) oz. avoir.

'A pint of pure water
Weighs a pound and a quarter.'

A more exact statement can be easily obtained.

2. WILLIAM SEYMOUR, South Shields.—A hole of $1\frac{1}{2}$ inch radius is cut through a sphere 14 inches in diameter, the axis of the hole being $3\frac{1}{2}$ inches from the axis of the sphere; required the volume of the waste, and the area of the spherical surface removed.



Let us take a central section of the sphere containing the axis of the cylindrical hole.

We judge it more instructive to work this problem with algebraical values, so as to obtain a general result. Let LAL' be axis of cylinder.

Let $CA=d$, $BA=AD=a$,
$CK=CO=\text{radius}=r$.

KM, K'M', CD are perpendiculars, as also is CNE, since $KN=NO$, $CD=d+a$, $CB=d-a$.

$$DK=\sqrt{CK^2-CD^2}=\sqrt{r^2-(d+a)^2}, \text{ so } BO=\sqrt{r^2-(d-a)^2}.$$

$$MO=\sqrt{r^2-(d-a)^2}-\sqrt{r^2-(d+a)^2};$$

$\therefore$ volume of frustum of cylinder KMO = (area of base KM) $\times LN=\pi a^2 . \frac{MO}{2}$

$$=\frac{\pi a^2}{2}\{\sqrt{r^2-(d-a)^2}-\sqrt{r^2-(d+a)^2}\}.$$

Call this expression x.

Also volume of cylinder $KMM'K'=\pi a^2 . KK'$

Call this y. $\qquad =2\pi a^2\sqrt{r^2-(d+a)^2}$.

Now the hole, of which O'K'KO is the plane section, is made up of (a) cylinder KMM'K, (β) two equal frusta KMO, K'M'O', (γ) two equal spherical segments KEO, K'E'O'. We must therefore proceed to find volume of KEO.

$$KO^2=KM^2+MO^2=4a^2+r^2-(d-a)^2+r^2-(d+a)^2$$
$$-2\sqrt{\{r^2-(d-a)^2\}\{r^2-(d+a)^2\}};$$
$$\therefore KN=\frac{KO}{2}=\text{(easily)}$$
$$\sqrt{\tfrac{1}{2}\{a^2+r^2-d^2-\sqrt{r^4+d^4+a^4-2r^2d^2-2a^2d^2-2a^2r^2}\}}.$$

Call this expression p.

$$CN=\sqrt{r^2-p^2},\ NE=r-\sqrt{r^2-p^2}. \quad \text{Call this } q;$$

$$\therefore \text{volume}=\frac{\pi . NE}{6}\{3KN^2+NE^2\} \text{ (by ordinary formula)}$$

$$=\frac{\pi q}{6}\{3p^2+q^2\}. \quad \text{Call this } z.$$

Hence total volume of waste $=y+2x+2z$.

In the given example $a=1\frac{1}{2}$, $r=7$, $d=3\frac{1}{2}$.

For the evaluation of p it should be noted that $r^4+d^4+a^4-2r^2d^2-2a^2d^2-2a^2r^2$ readily splits into factors.

It will be very instructive to imagine the extreme case in which the axis of the cylinder passes through the centre of the sphere, and its radius is equal to r. The whole sphere is evidently included, and we ought to get as our result $\frac{4}{3}\pi r^3$.

We have $d=0$, $a=r$. Hence $x=0=y$.

$$\text{Also } p=\sqrt{\tfrac{1}{2}\{r^2+r^2-\sqrt{2r^4-2r^4}\}}=r$$
$$q=r.$$
$$z=\frac{\pi r}{6}\{3r^2+r^2\}=\tfrac{2}{3}\pi r^3;$$

$\therefore$ whole volume $=y+2x+2z=\frac{4}{3}\pi r^3$.

3. A goods train starts from A to B at 12 o'clock, and a passenger train at 1 o'clock. After travelling $\frac{3}{4}$ of the entire distance, the former then goes at $\frac{2}{3}$ of its first rate, and is thereby overtaken by the latter at 20 minutes past 2, their distance from B being then 10 miles. The rate of the passenger train is twice the diminished rate of the other. Find the distance from A to B, and also the speed of each train.

Let x miles an hour be original rate of goods train.

y be distance from A to B.

$\frac{5x}{3}$ is rate of passenger train.

Distance from A when overtaken is $y-10$ miles.

Passenger train has done this in 1 hr. 20 min.;

$$\therefore y-10=\frac{4}{3}.\frac{5x}{3}=\frac{20x}{9}. \qquad (1)$$

Also for $\frac{3y}{4}$ miles goods train has travelled at x miles.

$\frac{y}{4}-10$ „ „ $\frac{5x}{6}$ „

$$\therefore 2\tfrac{1}{3}=\frac{3y}{4x}+\frac{\frac{y}{4}-10}{\frac{5x}{6}}. \qquad (2)$$

These two {(1) and (2)} readily give $20x=9y-90$.
$20x=9y-102\frac{6}{7}$.

But these equations are inconsistent, and therefore the problem under its present conditions is impossible.

4. From a certain station the angle of elevation of a tower is observed; 20 feet nearer to the base a new observation is taken, and the angle is the complement of the former; 6 feet nearer still, all in the same right line, another angle is taken, and found to be double of the first angle. Required the height of the tower.

Construct the following figure:—

Let AE be the tower; B, C, D, the successive points of observation. $ABC=\theta$, $ACD=90-\theta$, $ADE=2\theta$.

Let $AE=x=$height of tower, $DE=y$.

Then at once $\frac{x}{y+26}=\tan\theta$ (1). $\frac{x}{y+6}=\cot\theta$ (2).

$\frac{x}{y}=\tan 2\theta$ (3).

From (1) and (2) $\frac{y+26}{x}-\frac{y+6}{x}=\cot\theta-\tan\theta=\frac{2\cos 2\theta}{\sin 2\theta}$

$=\frac{2y}{x}$, by (3);

$$\therefore \frac{20}{x}=\frac{2y}{x}; \therefore y=10.$$

Also multiplying (1) and (2), $x^2=(y+6)(y+26)$
$=(10+6)(10+26)$;

$$\therefore x=4\times 6=24 \text{ feet.}$$

5. IVANHOE, Dronfield.—Inscribe a rhombus within a given parallelogram, so that one of the angular points of the rhombus may be at a given point on the side of the parallelogram (Todhunter's *Euclid*, Ex. 93).

Let ABCD be the parallelogram and E the point in the side AD. Then the student will easily be able to construct the figure, thus:—In CB take CF equal to AE. Join AC and EF meeting in G. Draw KGL perpendicular to EF. Then there will be two cases:—

(1) When KGL meets BC and AD before meeting AB and CD. Suppose this to happen. Let KGL meet BC in K and AD in L, K and L being between B and C and A and D respectively. Join EK, FL. Then EKFL is the rhombus; for the triangles AEG and FGC have all their angles equal (see Euclid I. 15 and I. 29). Hence AG is equal to GC, and EG to GF. But the diagonal BD must pass through the middle point of AC. Hence BGD is a straight line, and BG=GD, since the diagonals of a parallelogram bisect each other. Also by I. 15 and I. 29 again, BGK and LGD are similar, and BG=GD. Hence we must have KG=GL. We can now easily prove that EKFL is a rhombus. EG=GF, LG is common to the two triangles EGL, FGL, and EGL=right angle=FGL. Hence (Euclid I. 4) EL=LF. In a similar way we get LF=FK, and FK=EK. Hence EL = LF = FK = EK, or EKFL is a rhombus.

(2) When KGL meets AB and DC before meeting BC and AD, it will be found that although the rhombus is now inscribed in a slightly different sense, precisely the same wording applies for the proof.

There is still a third case.

(3) When KGL meets BC and AD first; but instead of con-

structing the rhombus as EKFL, we *produce* KGL to meet AB, CD in M and N respectively. Then it will be found that EMFN is a rhombus.

(4) Of course there is a similar extension when KGL meets AB and CD first.

In these latter cases, although part of the rhombus is *outside* the parallelogram, yet every angular point lies on the sides of the parallelogram, and hence, according to the ordinary definitions, it is *inscribed*, more properly *escribed*. We have still one other method of *escribing* a rhombus.

With this extended meaning of the definition, it is quite possible that other solutions may be found; in fact, there will certainly be one such solution when the diagonal EP of the rhombus lies in AD. It is easily found thus:—

Take Q, the middle point of AD, and find P such that EQ=QP; then draw RQS perpendicular to EP, meeting AB and CD respectively produced in R and S. Then it can be proved at once that ERPS is a rhombus.

6. If a triangle is described having two of its sides equal to the diagonals of any quadrilateral, and the included angle equal to either of the angles between these diagonals, then the area of the triangle is equal to the area of the quadrilateral (Todhunter's *Euclid*, Ex. 105).

Let ABCD be the quadrilateral, with diagonals intersecting in E. By trigonometry the result at once follows:—Area quad. $=\frac{1}{2}(AE.BE+BE.EC+EC.ED+ED.EA)\sin BEC$ $=\frac{1}{2}(AE+EC)(BE+ED)\sin BEC=\frac{1}{2}AC.BD\sin BEC$.

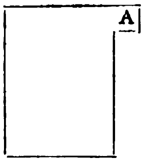
To adapt this to geometry, draw AH, CJ perpendicular to BD, and suppose the angle AEB acute. Let the triangle LMN have the angle LMN equal to AEB, LM equal to BD, and MN to AC. Draw NP perpendicular to ML. Then area of quadrilateral = sum of areas of triangles ADB, CDB $=\frac{1}{2}AH.BD+\frac{1}{2}CJ.BD=\frac{1}{2}(AH+CJ)BD$. But AEH=JEC=PMN, and EJC=right angle=EHA=MPN. Hence AEH, ECJ, MPN are similar. Hence (VI. 4),

$$AE : AH :: CE : CJ :: MN : PN$$
$$:: AE+CE : AH+CJ :: MN : PN$$
$$:: AC : AH+CJ :: MN : PN$$
$$:: MN : AH+CJ :: MN : PN;$$
$$\therefore AH+CJ=PN;$$

$\therefore$ area quadrilateral $=\frac{1}{2}PN.BD=\frac{1}{2}.PN.ML=$ area triangle.

In a similar way, the theorem can be proved when AEB is obtuse, the only difference being that P does not then fall between M and L. These obviously include all cases.

7. 'SUMMUM BONUM,' Oban, wishes information as to how to make a 'commonplace' book, also would like to know what Locke's plan is. We believe that this latter scarcely differs at all from the ordinary one for an *Index Rerum*. Our correspondent must surely have seen little pocket-books with 'Where is it?' on the back. An *Index Rerum* is simply an enlarged edition of this. It can be easily made as follows. Take an ordinary exercise-book, value about 1s., and snip off a narrow column from the outer edge of the first ten pages, say, leaving only a square piece at the top, on which write A, thus:—



For the next letter snip off a similar narrow column, leaving a piece at the top twice as deep as before, and write B on the *lower* part of this, so that, when the book is shut, *both* the A and B will be distinctly visible. Continue this process throughout the alphabet. Thus, since each letter is visible without opening the book, you can turn at once to any particular one, and are saved the trouble of an interminable index. We would recommend our correspondent, if he deems it advisable to keep any such thing at all, to keep two—one strictly an *Index Rerum*, the other a quotation-book. The use of the first is almost obvious. Whenever, in reading a standard book in your possession, you come across a passage that strikes you as able to bear a second reading, and these will be few enough, make a note of its position, cataloguing it under the most prominent word or thought, and adding a few descriptive hints to remind you of what it is treating, so that you can see at once whether you have got hold of the right one when you look it up again. The following is a specimen entry, for instance, all easily compressible into one line of small manuscript:—

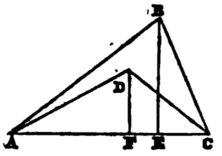
'Life, allegorical picture of, Carlyle, *Sartor Resartus*, Bk. iii. chap. viii. p. 184, People's Edn.'

It is hopeless to attempt to arrange the heads in strict alphabetical order. You must be content with having all of one initial letter together, and add others just as they come, without reference to their proper sequence. In shorthand, too, several notes might with advantage be added, such as, 'Suitable for peroration,' of a speech. Probably one word, 'peroration,' would be a sufficient reminder in this case.

The quotation-book should *never* be used for standard books, books in your own possession, or books that you can easily obtain, otherwise it will be full far sooner than you wish it. Any passage in a book which you meet once, and are not likely to meet again, or any jotting from an ephemeral magazine that pleases you, should be transferred bodily, and then its position in the quotation-book registered in the *Index Rerum*.

In conclusion, we would advise our correspondent not to attempt the formation of such books until his literary tastes are fully formed, otherwise it may happen that a year after the book is made it will annoy him by its very stupidity, for he will have lost the taste for some passage which then quite took his fancy, but now seems wonderfully weak.

8. R. GIBBONS, Stockport.—One diagonal of a quadrilateral, which lies outside the figure, is 70 feet, and the difference of the perpendiculars upon it from the extremities of the other diagonal is 16 feet. Find the area.



Let ABCD be the quadrilateral, AC the diagonal outside the figure. Then we are given AC=70, BE−DF=16, where BE and DF are perpendiculars on AC.

Now quadrilateral ABCD = triangle ABC − triangle ADC
$=\frac{1}{2}AC.BE-\frac{1}{2}AC.DF$
$=\frac{1}{2}AC(BE-DF)$
$=\frac{1}{2}.70.16=560$ sq. feet.

9. W. H. W., Westfield.—Given one side of a right-angled triangle, and the sum or difference between the hypotenuse and the other side to construct the triangle.

We will first suppose the difference given.

Let AB be the given side. At B erect BD perpendicular to AB, and make BD equal to the given difference. Join AD, and at A make the angle DAC equal to the angle ADB, and produce AC and DB to meet in C. Then ABC is triangle required, for AC − CB = CD − CB = BD = given difference, and ABC is a right angle.

Secondly, if the sum is given.

The construction will be found precisely the same, the figure differing in that C now lies between B and D.

Or a method of solution might be derived at once by algebra. Let d=given difference, x and y the unknown sides, b the given base. Then $x^2-y^2=b^2$, $x-y=d$, $x+y=\frac{b^2}{d}$. Hence on the given difference or sum construct a rectangle equal in area to the square on the given base; its other side will be the sum (or difference) of x and y. The rest is obvious; $x-y=d$, $x+y=\frac{b^2}{d}$, $x=\frac{d+\frac{b^2}{d}}{2}=\frac{d^2+b^2}{2d}$, the form of which suggests another direct construction for x. Find a rectangle one of whose sides is $2d$, and whose area is equal to that of the square on AD in the former part of the question; its other side is x.

10. R. J. WHITE, Woolwich, wishes to know if there is any annotated editions of Wordsworth's 'Ode to Duty,' 'Ode to Immortality,' and 'Poems dedicated to National Independence and Liberty.'

We do not believe that any such is yet published; we have certainly not met with them, nor is any one mentioned in the last number of the *Bookseller's Catalogue*. Messrs. Rivington publish an annotated edition of several miscellaneous poems of Wordsworth; but as we have not yet had an opportunity of examining this, we cannot say whether any of those you mention is among them. The price is 1s. If not successful there, try Chambers. See 'Reviews' in this number.

11. AN IMPERFECT GRAMMARIAN wishes an explanation of the phrases:—'*it weighed six pounds;*' '*it was three ells long;*' '*methinks;*' '*it is worth sixpence;*' '*the more the merrier;*' '*a dog yclept Pompey;*' '*if you please.*'

We do not wonder that Lindley Murray failed to satisfy you. Try Mason's *English Grammar*, to the value of which more than twenty editions are sufficient testimony. Publisher, G. Bell, price 3s. 6d. It will solve all your difficulties. Bain's *Com-*

panion to the Higher English Grammar you would find a very useful book in teaching that subject. It makes an especial point of discussing such phrases. Publisher, Longmans, price 3s. 6d.

12. R. C. BEAN wishes a complete list of guide-books, books, and periodicals bearing on the London 1st B.A.

This is a scarcely reasonable request. We can only say that Mr. Sparkes has produced a guide to the 1st B.A. which possibly may do you some little good. Ask your bookseller for it. To get an idea of what your request would mean, refer to the last two or three pages of his work, and you will find a list complete enough to please any one, on the assumption that completeness and bulk are identical. We have not the slightest objection to give you advice to aid your choice of books on special subjects, say Classics or Mathematics, or to help you in any other dilemma, but we really could not admit such a wholesale tax on our space, especially in a case in which many booksellers could relieve you at once.

13. H. W. CROWE, Otley.—Find two mean proportionals between 3 and 24.

If they be $3r$, $3r^2$; 3, $3r$, $3r^2$, and 24 must be a G.P.; $\therefore 3r^3 = 24$, $r^3 = 8$, $r = 2$, and hence the proportionals are 6 and 12.

At what time between 11 and 12 o'clock are the hour and minute hands of a watch—1st, together; 2d, at right angles; 3d, directly opposite.

1st. They are together at 12 o'clock, and at no other time between 11 and 12.

2d. Let them be at right angles x minutes before 12. Then the minute hand has x minute space to traverse, and (construct a figure) the hour hand $\{x + 15 \text{ (= right angle)} - 60\}$ minute spaces before reaching 12 o'clock. But the minute hand goes at 12 times rate of hour hand;

$$\therefore \frac{x}{12} = x - 45; \therefore \frac{11x}{12} = 45,$$
$$x = \frac{540}{11} = 49\frac{1}{11}.$$

Hence the event happens at $10\frac{10}{11}$ minutes past 11.

3d, opposite. In a similar way the minute hand has y minute spaces, hour hand has $\{y + 30 \text{ (= 2 right angles)} - 60\}$.

Hence $\frac{y}{12} = y - 30$, $y = \frac{360}{11} = 32\frac{8}{11}$.

Hence the hands are opposite at $27\frac{3}{11}$ minutes past 11.

14. J. W. PEGG, Barlestone.—A person wishing to know the height of a wall, the foot of which was inaccessible, fixed an upright staff five feet high (the height of his eye) at the place where the angular altitude above the level of his eye was 45°. Having then walked backwards till the angle between the top of the wall and the top of the staff was 18° 26′, of which the tangent is $\frac{1}{3}$, he found by actual measurement that his distance from the staff was 70 feet.

Determine the height of the wall.

Let EG be wall, CD the staff, AB the man in second position, BDG the ground (horizontal), ACF likewise horizontal and parallel to BDG. Join AE, CE.

Then EAF = 18° 26′, ECF = 45.

Let EG $= x$, EF $= x - 5 =$ CF $\{\because \angle CEF = ECF\}$.

AC = 70; $\therefore$ AF $= 70 + x - 5 = 65 + x$.

$$\frac{EF}{AF} = \tan EAF = \tan 18° 26' = \tfrac{1}{3};$$

$$\therefore \frac{x-5}{x+65} = \tfrac{1}{3},\ 3x - 15 = x + 65,\ 2x = 80,\ x = 40;$$

$\therefore$ the tower is forty feet high.

15. FRERE, Barrow-in-Furness, wishes to know how she may obtain a certificate 'for an extra subject such as French, so as to be eligible for a situation where it is required.'

We think your best plan would be to take the Cambridge Higher Local Examinations for Women. Certificates are there given for proficiency in special subjects, which would be of considerably more value than that of a visiting inspector, as you suggest. The secretary, Rev. G. F. Browne, St. Catharine's College, Cambridge, will send you a copy of the Regulations, etc., post free, on application.

16. J. D. M., Weston-super-Mare.—A grocer buys 2 cwt. of tea. The first cwt. he sells at 5 per cent. profit, and the second cwt., which costs £1 more, at 12 per cent. profit, the difference of the retail price being 4d. per lb. Find the cost price per lb. of each kind.

Suppose wholesale price of first kind £x per cwt.

Then wholesale price of second kind is £$(x + 1)$ per cwt.

Hence selling price of first kind £$\frac{21x}{20}$ per cwt., since there is a profit of 5 per cent.

And selling price of second kind is £$\frac{28}{25}(x+1)$ per cwt., since there is a profit of 12 per cent.

But the retail prices differ by 4d. per lb., *i.e.* £$\frac{28}{15}$ per cwt.;

$$\therefore \frac{28}{25}(x+1) - \frac{21x}{20} = \frac{28}{15}.$$

Multiply by 300:—$336(x+1) - 315x = 560$,

$21x = 224$, $x = £10\frac{2}{3}$ per cwt.

$$= \frac{\overset{2}{\cancel{32}} \times 20}{3 \times \underset{7}{\cancel{112}}}\text{s. per lb.} = \frac{40}{21}\text{s.} = 1\text{s. } 11\text{d. nearly.}$$

Price of second kind is £$(x + 1)$ per cwt. $= £11\frac{2}{3}$ per cwt.

$$= \frac{\overset{5}{\cancel{35}} \times \overset{5}{\cancel{20}}}{3 \times \underset{\underset{4}{\cancel{16}}}{\cancel{112}}} = \frac{25}{12}\text{s. per lb.} = 2\text{s. } 1\text{d. exactly.}$$

17. An up-train, 88 yards long, travelling at the rate of 35 miles an hour, meets a down-train, 88 yards long, at 12 o'clock, and passes it in 6 seconds. At 15 minutes and 3 seconds past 12 the up-train meets a second down-train, 132 yards long, and passes it also in 6 seconds. At what time will the second down-train run into the first?

In such sums we find the time in which one train will pass another, as follows:—Suppose one train at rest and the other to move with a velocity equal to the sum of the two velocities of the trains. Then the moving train will first reach the engine of the other train, then the other end, then its whole length will have to pass this other end. Hence the rule: Divide sum of lengths of trains expressed in miles by sum of velocities of trains. The result will be the time occupied in passing.

Thus the total velocity of the two trains here is such that 176 yards are traversed in 6 seconds, *i.e.* 88 feet per second, *i.e.* 60 miles per hour. But one train moves at 35 miles; hence the other moves at 25 miles.

Similarly in the second case 220 yards are traversed in 6 seconds; $\therefore$ the total rate is $82\frac{1}{2}$ miles per hour; $\therefore$ the rate of the second train is $47\frac{1}{2}$ miles per hour.

Also the first down-train and the up-train are separating at 60 miles per hour; hence in $15\frac{1}{20}$ minutes they will be $\frac{301}{20}$ miles apart.

Now the two down-trains are decreasing the distance between them at $47\frac{1}{2} - 25 = 22\frac{1}{2}$ miles per hour; $\therefore$ they will cover $\frac{301}{20}$ miles in $\frac{301 \times \cancel{2}}{\underset{10}{\cancel{20}} \times 45} = \frac{301}{450}$ hour, *i.e.* 40 minutes 8 seconds.

Hence the trains run into one another at 55 minutes and 11 seconds past 12.

18. If 8 men and 6 boys reap 15 acres in 2 days, and 5 men and 8 boys can reap 23 acres in 4 days, how many boys will be required along with 3 men to reap 17 acres in 4 days?

Suppose a man to be as efficient as x boys.

8 men and 6 boys $= 8x + 6$ boys reap 15 ac. in 2 days,

1 boy reaps 1 ac. in $\frac{2(8x+6)}{15}$ days,

$5x + 8$ boys reap 23 ac. in 4 days,

1 boy reaps 1 ac. in $\frac{4(5x+8)}{23}$ days.

Hence $\frac{2(8x+6)}{15} = \frac{4(5x+8)}{23}$, $51 = 17x$, $x = 3$.

Hence 1 boy reaps 1 ac. in 4 days, 17 boys reap 17 ac. in 4 days.

17 boys = 9 boys + 8 boys = 3 men + 8 boys.

19. W. S., Wirksworth.—Which English battle from 1300 to 1400 is considered by Froissart to have been the best fought? What other historians agree with him?

Cressy, we believe, but can scarcely pretend to be answerable for or even fully conversant with Froissart's opinions; nor is it quite fair to expect us to know whether any of the numerous gentlemen fated to write history agreed with him. Some do, we believe.

20. C. W. EASTON, Gressenhall.—Pitman's System of Shorthand, which he calls Phonography, is very much the best. Its general use is attested to by the fact that of the sixteen reporters on the staff of the *Times*, eight are phonographers. The acquirement is not a matter of a moment. Practise honestly an hour a day for a year, and we can assure you of 100 words per minute. Three years' practice will bring you to 180, and this is the limit. Purchase from F. Pitman, Paternoster Row, *The Phonographic Teacher* (price 6d.), and *Exercises in Phonography* (1d.). After that, the *Manual* and *Reporter*. But we refer you to Pitman's books for further instruction.

Order the Syllabus for the Elementary Teachers' Certificate Examination from any bookseller.

As to studying Virgil's *Æneid*, Books I.-III., *do not get a translation.* We have previously, in these columns, recommended Bryce's edition, which is fully enough annotated. You may, but we hope you never will, find a literal prose translation in Bohn's 'Classical Library.' Conington's verse translation is the best, but there are no notes.

21. BRISTOLIAN, Bristol, DELMER, and others.—Is there any rule to arrange the digits 58, 967, 537, so that the number formed may be divisible by 19?

These digits naturally split up into four sets of two, 57, 95, 76, 38. Each pair is divisible by 19, and thus the numbers formed by arranging these pairs of digits in any order would satisfy the condition. There are evidently twenty-four such numbers. It seems to us that there can be no general rule for such sums; for, to take one instance only, the number formed by *nineteen nines* is divisible by 19, no matter in what way we arrange these nines. Now if it were possible to find a general rule to include all cases, we have a fair right to apply it to this particular one, and we obtain several arrangements of these nines as being the *only* ones which will give a resultant number satisfying the condition. This is absurd.

22. W. R., Shetland.—A railway train, after travelling for one hour, meets with an accident which delays it one hour; after which it proceeds at three-fifths of its former rate, and arrives at the terminus three hours behind time. Had the accident occurred 50 miles farther on, the train would have arrived 1 hour 20 minutes sooner. Required the length of the line, and the original rate of the train (Todhunter's *Algebra*, p. 103, Ex. 25).

Let x=original rate of train, y=distance between places.

In 1 hour train goes x miles; ∴ there are $y-x$ miles to do after the accident, at $\frac{3x}{5}$ miles per hour; ∴ it takes $\frac{5(y-x)}{3x}$ hours.

Hence in the journey altogether it takes $\frac{5(y-x)}{3x}+2$ hours, since it is delayed 1 hour. But it should have taken $\frac{y}{x}$ hours;

$$\therefore \frac{5(y-x)}{8x}+2=\frac{y}{x}+3;$$

$$\therefore 5(y-x)=3(y+x),\ 2y=8x,\ y=4x.$$

In the second case there are $y-50-x$ miles to be done at reduced speed; ∴ it takes $\frac{5(y-50-x)}{3x}$ hours. Also it would do 50 miles in $\frac{50}{x}$ hours; ∴ before the accident it had been travelling $1+\frac{50}{x}$ hours;

$$\therefore \text{it was } \frac{5(y-50-x)}{3x}+\frac{x+50}{x}+1 \text{ hours on the route}$$

$$=(\text{as before})\ \frac{y}{x}+\left(3-1\frac{1}{3}\right)$$

$$=\frac{y}{x}+\frac{5}{3};$$

$$\therefore 5(y-50-x)+3(x+50)+3x=3y+5x,$$

$$5y-250-5x+3x+150+3x=3y+5x;$$

$$\therefore 2y-4x=100,\ 8x-4x=100,\ \text{since } y=4x,\ x=25,\ y=100.$$

23. Two persons, A and B, could finish a work in m days; they worked together n days, when A was called away, and B finished the work in p days. In what time would each do it? (Todhunter's *Algebra*, p. 104, Ex. 27.)

Suppose A could do it in x days, *i.e.* $\frac{1}{x}$th a day.

B ,, in y days, *i.e.* $\frac{1}{y}$th a day.

In m days A does $\frac{m}{x}$ths, B $\frac{m}{y}$ths, but they finish it together;

$\therefore \frac{m}{x}+\frac{x}{y}=1.$

In n days they do $\left(\frac{n}{x}+\frac{n}{y}\right)$ of it. In p days B does $\frac{p}{y}$ths of it; $\therefore \frac{n}{x}+\frac{(n+p)}{y}=1,\ \frac{m}{x}+\frac{m}{y}=1.$

Solve these simultaneous equations in $\left(\frac{1}{x}\right)$ and $\left(\frac{1}{y}\right)$.

$$\text{Hence } x=\frac{pm}{p+n-m},\ y=\frac{pm}{m-n}.$$

24. A body weighing 6 lbs. is placed upon a smooth plane which is inclined to 30° to the horizon; find the two directions in which a force equal to the weight of the body may act to produce equilibrium. Also find the pressure on the plane in each case (London Matriculation, 1873).

Let us denote the force applied by P, the resistance by R. Then the body is in equilibrium under W, P, and R, and W=P; therefore R bisects the angle between P and W. Hence the construction. Draw the vertical through the point and the normal to the plane at the point, and take a line on the other side of the normal, making the same angle 30° with it as W does. Then this is one direction.

Also for the magnitude of the pressure, resolving normally. $R=2W\cos 30^\circ=2W.\frac{\sqrt{3}}{2}=W.\sqrt{3}$, for both P and W are inclined at an angle of 30° to the normal in which R lies.

The second direction of P is evidently given by the vertical. W and P, directly opposite and equal, counterbalance one another, and R=0; in other words, the particle is on the point of being lifted off the plane.

25. W. T. F. W., Fort-William.—A plantation in the shape of an ellipse has diameters which measure respectively 110 yards and 73 yards 1 foot; how many stakes will be required to fence it, if they are placed 10 inches apart?

To do this problem exactly, it is evidently necessary to know the perimeter of an ellipse, and this is unfortunately a problem which mathematical analysis has as yet utterly failed to solve. It involves a knowledge of elliptic integrals and higher transcendants. We will, however, give an approximate solution. Let the semi-arc be a and b; then the perimeter of the minor auxiliary circle is $2\pi b$, of the major auxiliary circle $2\pi a$. Now the perimeter of the ellipse must lie between these two, and the method of Least Errors would lead us to expect that we shall be nearest the truth in taking $\sqrt{\frac{(2\pi a)^2+(2\pi b)^2}{2}}=\pi\sqrt{2(a^2+b^2)}$ as the value of the perimeter of the ellipse. Although this is not the exact truth, it is near enough when $\frac{b}{a}$ is not very small. In this case $2a=330$ feet, $a=165$ feet, $2b=220$ feet, $b=110$ feet.

$$\sqrt{2(a^2+b^2)}=\sqrt{2.55^2\{2^2+3^2\}}=55\sqrt{26}.$$

Now $\sqrt{26}=5{\cdot}099$. Hence the perimeter $=\pi\times 55\times 5{\cdot}099$ $=\pi\times 280{\cdot}445$ feet$=$ (taking π as $3{\cdot}14159$) $881{\cdot}043$ feet. And there is a stake every 10 inches, therefore there are $\frac{6}{5}\{881{\cdot}043\}$ stakes, *i.e.* taking the integral part only, 1057 stakes altogether.

As we have said, this is not the exact answer, and, in fact, we cannot be certain of anything except that the number lies between 1050 and 1060. There is *no elementary method* of arriving at a more exact result.

26. PRECEPTOR.—(1) No; the diploma would be useless to you as a teacher in an elementary school.

(2) Currie's *Common School Education* (Stewart & Co.) would suit you admirably.

27. An octagonal prism is 40 feet long, and each side of its end is 10 feet. Required its volume.

General formula for area of an equilateral polygon is $\frac{na^2}{4}\cot\frac{\pi}{n}$, where a is length, and n the number of sides.

Here $a=10$, $n=8$, area $=200\cot 22\frac{1}{2}$.

$$\text{Now }\cot 22\tfrac{1}{2}=\frac{1+\cos 45}{\sin 45}=\frac{1+\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}}}=\sqrt{2}+1.$$

Hence area $=200(\sqrt{2}+1)$.

Hence vol. of whole prism $=8000(\sqrt{2}+1)$ cubic feet $=19{,}313$ cubic feet, taking $\sqrt{2}$ as $1\cdot414$.

28. A hexagonal prism is $50\frac{1}{2}$ feet long, and a straight line across the centre of its end from corner to corner is 30 inches. Required its volume.

Let ABCDEF be the hexagon, join AD, and let fall BL, CM perpendiculars on AD. Then BAF is the angle of a regular hexagon $=120°$ (Euc. I. 32, Cor.).

Hence BAL $=60°=$ CDM. Hence AD $=$ AB cos 60 $+$ BC $+$ CD cos 60 $=\frac{AB}{2}+BC+\frac{CD}{2}=2BC$, as might have been otherwise inferred from Euc. IV. 15, since the centre of the circle circumscribing the hexagon lies at the centre of AD. Hence the length of side is 15 inches $=\frac{5}{4}$ feet. Hence, as before, the area $=\frac{6.(\frac{5}{4})^2}{4}\cot 30°$. Hence volume $=\frac{7575\sqrt{3}}{64}$ cubic feet $=$ (taking $\sqrt{3}$ as $1\cdot7320$) $204\cdot9$ (approximately).

29. 'NIL,' Holbeck.—We think you will find Clyde's *Geography* far the best—the larger edition, we mean.

30. SUBSCRIBER, Nottingham.—If $a+b+c=0$, show that $2(ab+bc+ca)^2=a^4+b^4+c^4$.

$$\begin{aligned}(ab+bc+ca)^2&=a^2b^2+b^2c^2+c^2a^2+2abc(a+b+c)\\&=a^2b^2+b^2c^2+c^2a^2.\end{aligned}$$

Also $2a^2b^2+2b^2c^2+2c^2a^2-a^4-b^4-c^4$

(by ordinary formula or by multiplication; see a former number of this Query Column)

$$=(a+b+c)(a+b-c)(a-b+c)(b+c-a)=0,$$
$$\because a+b+c=0.$$

Hence the rest is obvious.

31. SUBSCRIBER, Meikleour.—There is a certain number consisting of 3 figures; the sum of the digits is 7; twice the sum of the extreme digits is equal to 5 times the mean, and if 297 be subtracted from the number, the digits will be inverted. What is the number?

Let x, y, and z be the digits. Then $100x+10y+z$ is the number.

$$\text{Also } x+y+z=7 \quad . \quad . \quad . \quad . \quad (1)$$
$$2(x+z)=5y \quad . \quad . \quad . \quad . \quad (2)$$
$$100x+10y+z-297=100z+10y+x,$$

i.e. re-arranging and cancelling 99,

$$x-z=3 \quad . \quad . \quad . \quad . \quad (3)$$

(1), (2), and (3) are three simultaneous equations, whence we get at once $x=4$, $y=2$, $z=1$, or the number is 421.

32. To recommend a book on algebra to you, unless you name further particulars, is hard. Hamblin Smith (Rivingtons, price 3s.) is very profuse in his explanation of difficulties. Todhunter's smaller work (Macmillan, 2s. 6d.) will carry you as far, and in a more scientific, though not so easy fashion. Todhunter's larger work (Macmillan, 7s. 6d.) is by all means the best, if suited to your requirements.

33. ALGEBRAIST, Montrose.—(1) Factors for x^2+4x-1, and similar sums.

Solve the quadratic in x:—$x^2+4x-1=0$, $x=-2\pm\sqrt{5}$. Hence the factors are $x+2-\sqrt{5}$, and $x+2+\sqrt{5}$.

In general, $ax^2+bx+c=a(x-\alpha)(x-\beta)$, where

$$\alpha=\frac{-b+\sqrt{b^2-4ac}}{2a},\quad \beta=\frac{-b-\sqrt{b^2-4ac}}{2a}.$$

(2) There are x students in one class, y in another, but z attend both. Find an expression for the whole number of students. $x+y-z$, as is surely evident.

(3) The angles of a four-sided figure, taken in order, are as the numbers 1, 2, 3, 4. Prove that two opposite sides are parallel. Let x, $2x$, $3x$, $4x$ be the angles. Then, since sum of angles of a quadrilateral is equal to 4 right angles,

$$x+2x+3x+4x=360,\ x=36.$$

Hence the angles are 36°, 72°, 108°, 144°; and as $36°+144°=180°=72°+108°$, it follows by Euc. I. 28 that two opposite sides are parallel.

The sides of a triangle are 6, 7, and 8. Find the segments into which the bisector of the mean angle divides the opposite side.

The mean angle is the angle opposite side 7. Let the segments be x and $7-x$, x being near to the angle formed by 6 and 7.

Then by Euc. VI. 2, $6:8::x:7-x$;

$\therefore 6:14::x:7$, *componendo;*

$\therefore x=3$; $\therefore$ the segments are 3 and 4.

34. PUPIL TEACHER, Stratford.—We must refer you to any work on Trigonometry or Geodesy for the method of measuring mountains.

35. The publisher of Brook-Smith's Arithmetic is Macmillan & Co., price 4s. 6d.

36. Oranges are bought for 2s. 6d. a hundred; some are sold at 3s. 6d. per hundred, and the rest at 2s. 10½d. per hundred. The same profit is made as if they had all been sold at 3s. 1½d. a hundred. Of 1000 oranges sold, how many fetch 3s. 6d.?

Suppose x fetch 3s. 6d., then $1000-x$ fetch 2s. 10½d., and total receipts are $\frac{7x}{2}+\frac{23(1000-x)}{8}$ shillings. But we are told also that these receipts are the same as if all had sold at 3s. 1½d.

$$\text{Hence } \frac{7x}{2}+\frac{23(1000-x)}{8}=1000.\frac{25}{8},$$
$$\text{or } 28x+23000-23x=25000;$$
$$\therefore 5x=2000,\ x=400.$$

37. J. S., Dumfries.—Solve (1) $x^2+y=4$.
(2) $y^2+x=10$.

Substituting from (1) in (2) for y,

$$(4-x^2)^2+x-10=0;$$
$$\therefore x^4-8x^2+x+6=0;$$
$$\therefore x^4-8x^2+7+x-1=0;$$
$$\therefore (x^2-7)(x^2-1)+x-1=0;$$
$$\therefore x=1 \text{ or } (x+1)(x^2-7)+1=0. \quad . \quad (3)$$

The value $x=1$ gives $y=3$, and this is the only solution which is both rational and integral.

The cubic equation (3), which gives us others, may be dealt with thus:—Write it $x^3+x^2-7x-6=0$. Since it consists of a set of positive terms followed by a set of negatives, it has only one real root (see *Theory of Equations*).

Call the equation $f(x)=0$. Then $f(2)=-8$, $f(3)=9$; hence the root lies between 2 and 3. Put $x=2+\frac{1}{y}$, and multiply by y^3. The equation becomes $8y^3-9y^2-7y-1=0$. If this expression be $\phi(y)$, $\phi(1)=-9$, and $\phi(2)=13$. Hence there is a root between 1 and 2. Hence, finally, the only other value of x that is real is about $2\frac{5}{8}$, whence $y=-2\frac{3}{4}$ about. Or the equation might be dealt with in the ordinary way for cubics.

38. Write again more definitely for instructions as to Science and Art Mathematical Examination, stating what proficiency you have attained, and what books you have read. We shall then be glad to advise you.

39. Subtract—

mls.	fur.	po.	yds.	ft.	in.
8	0	0	0	0	0
7	7	39	5	2	10

The latter quantity $=8$ miles 1 ft. $+4$ inches. Hence, if required to subtract the second from the first, the answer is -16 in.

40. H. M. M.—Write to Mr. James Jennings, Deptford, S.E., and Mr. Tudor Rogers, Chester.

41. T. ELLIOT, Grindal School, Yorks.—The 'fish' is not a fish at all, but one of the cuttles—the Common Squid. The circular cups on the arms are for suction, in order to capture prey. There is a full account of it and its relatives in Wood's *Illustrated Natural History*, vol. iii.

*** *In communications to this column, correspondents must in all cases remember to send us their names, not necessarily for publication, but as a guarantee of good faith, and for facility of reference.*

THE Practical Teacher

A MONTHLY EDUCATIONAL JOURNAL

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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Health at School.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),

President of the Council of the British Medical Association.

No. IV.—BATHS AND BATHING.

INTIMATELY associated with the subject of water-supply, is that of baths and bathing. Every large school should have a swimming-bath attached to it as a part of its establishment as an educational institution. If there is a stream of clean water in close proximity to the school, it may be possible for the managers to make such arrangements as may render the stream available for the purpose; but it is necessary that there shall be good supervision of the bathing-place, otherwise accidents are likely to happen, and the managers will not, in that case, be quite free from blame. They know that boys will always be boys, and that they will get into danger if they are not controlled by wiser heads, and that then occasionally there will be a death from drowning.

It is culpable negligence on the part of the managers not to provide for this. It is their duty, by proper regulations, to prevent the possibility of its occurrence. Schools containing several hundred boys will be incomplete unless they have a swimming-bath of their own, or one in some way open to them. There ought to be a standing rule in every school, that swimming should be as much a part of education as cricket or music; or even more so, because it may chance to any one to have his own life, or that of a fellow-creature, lost for want of this knowledge; whilst such loss could not arise for want of acquaintance with the rules of cricket or football. Managers of all schools should therefore look out for bathing-places in safe situations, and make proper arrangements for their supervision. If there is a public swimming-bath in the district, they should negotiate with the managers of the bath for the periodical admission of their scholars to its advantages, and if this cannot be done on satisfactory terms, they should establish a swimming-bath under their own management. Those who happen to be acquainted with the pauper establishment at Anerley, may easily know the good results which follow from the rule at that school, which makes every boy learn to swim before he finally leaves its roof. There would be an advantage in the same rule being applied to girls. That which a pauper school does, cannot be very difficult for elementary schools to do, and there can be no difficulty in the way of private adventure-schools doing it. There are some districts where it will be impossible from the absence of sufficient water, but it is very exceptional, as it need not apply to any place having a rainfall of twenty-five to thirty inches per annum. It will generally be easy to secure a basin, into which rain-water may be diverted, which will serve the purpose; whilst, if there be a water company, water may always be obtained. If the bath be properly placed, the water could afterwards be used by the local authorities as a means for flushing the public sewers at regular intervals, and, if used by elementary schools, it ought to be possible for a mutual arrangement to be made, by means of which the cost should be small to the school authorities, and not be any additional charge upon the ratepayer. School education, either public or private, is not complete which does not teach children that a clean skin is a necessity, independently of the advantage of being at home in the water. If all children were washed all over the body, only once a week, it would tend to diminish the incidence of infectious disease generally, and also to prevent some of that unpleasant odour which too often belongs to the atmosphere of a schoolroom when full of pupils. I recommend all school authorities to encourage bathing as much as possible every day in hot weather, and at least once a week in cold; let it take its place in the drill of the school, and be considered a part of the education of the child, attendance at the bath counting in the time-table. It will encourage an exercise which is important as regards the health of the children, whilst it will give confidence to them when in danger, and make them better citizens when they have come to years of discretion. A knowledge of this accomplishment will help to train a child. A boy that can swim is worth much more in every-day life than a boy who cannot. A child who has been accustomed to plunge into cold water will be much less likely to suffer from sudden alteration of temperature than one who is never washed in this way, whilst if by chance he should get wet through by a sudden storm, he will be less likely to be chilled or laid up by fever. Cold bathing is also much more advantageous than warm baths: there is considerable danger from the too frequent application of the latter, as the following incident will show.

A number of medical men were, some years ago, assembled together at Edinburgh, when a remark was made that croup seemed to be occasionally epidemic in the winter months. On comparing notes, it was made out that Saturday night was the usual time at which it occurred; a few further inquiries showed that tubbing-night provoked the attacks, and that there were dangers even in cleanliness.

Hot baths in a steaming atmosphere in cold seasons of the year are likely to do damage to sensitive temperaments. I will give another illustration.

Two large families lived next door to each other in precisely similar conditions. It was found on comparing notes, that at one house the doctor (myself) was frequently in attendance for croup or bronchitis, or some other malady; whilst in the other case his visits were infrequent. I advised that the reason consisted in the hot baths with which the children were treated every morning by a self-willed nurse in the one case, whilst in the other the children were daily accustomed to a cold dip. The washing with warm water was given up in the delicate family with rapidly manifest advantage to them, and a serious diminution of the fees which I was accustomed to receive from the family. It was not long before the one family became nearly as healthy as the other; but it was years before the delicacy which the hot bath induced could be eradicated. Warm water is pleasant to wash with, but it is not advantageous for children habitually to use it in cold climates. No bath should be habituually used in cold weather which is above sixty degrees in temperature.

It is not advisable for children when going to bathe to chill themselves whilst undressing. This operation must be performed as rapidly as possible. The child should pass into the water as soon as he is undressed, and not remain in too long. First immersions should be for a few minutes only, the time being increased as the child becomes more accustomed to it; but cold bathing should not be begun in cold weather. He must be instructed to scrub himself dry with a rough towel, and not to dress until this drying, especially of the feet, has been thoroughly effected. The early morning is the best time for a bath; but if this be inconvenient, it should be between meals, and not when the stomach has been recently filled. Children should not be allowed to bathe immediately after a meal. The time for bathing should not be taken from their recreation, but should come into and be a part of school-work, and be always superintended by a master. It will be found that this will be an advantage in elementary schools, in the fact that the children's hair will be washed at regular intervals by this plan; and it will be advisable also for them to be instructed to keep the hair cut short, so as to enable it to be dried more quickly. Attention to drying the hair should be a part of the drill, and boys who have returned to study with wet heads should be sent out to dry them by a good rubbing. Day-schools cannot be expected to provide hot baths, but no boarding-school is properly furnished which is not supplied with a series of baths for washing purposes, and for use in cases of sudden illness. If there is no swimming-bath, it is easy to have a common bath with cold water, so that a cold douche can always be had. These hot baths are advantageous in those great schools in which boys are liable to be exposed to sudden immersions in cold water, as when rowing, and after football, in cold and wet seasons, when they become covered with mud. The hot bath may save them from bad consequences, provided they have a cold douche immediately on coming out of it. The hot bath then refreshes the system, and no harm is likely to be effected by the relaxed condition which a hot bath leaves when the cold douche is not used. When a man or a boy has a hot bath whilst in health, he should always use the cold douche before drying himself, and then his hot bath will do him no harm, but really refresh him. The baths should be so situated as to allow of the water which has been used for washing purposes, being also used for flushing the drains. For this purpose it is requisite that the waste-pipe from the bath should be equal in diameter to that of the drain which is to be flushed, or else for the drain to be fitted in some part of its course with a penstock, which can be put down and kept *in situ* until the drain is quite full of water. If, then, the penstock be raised, there is a full flush, and the whole calibre of the pipe is properly washed out. Flushing, as ordinarily carried on, as against some of the dangers of sewers, is all but useless. Certain forms of developments take place on the upper sides of sewers which allow of fungoid growths. It is possible that some of these growths are intimately related to the production of germs capable of setting up morbid results when inhaled by certain sensitive temperaments. Flushing, to be really effective, must sweep the roof as well as the floor of the sewer, and by that means empty out the sediment which may be at the bottom of the drain; and also the bacteria, the spirillæ, and the vibrios which occupy the roof, and with these removes the foul air which fills the calibre of the sewer. These operations can only be effected by means of a proper supply of water. It is, however, waste to use water for such a purpose which has not been used for some other, and that other purpose is naturally for human washing. The waste water of baths in all large schools should be intimately connected with its kindred work, flushing the sewers; and for this purpose the bath should always be placed at the highest point on the school premises, so as to command every part of the drain, and to be capable of being discharged so as to fill its whole calibre. I must give a caution as to the continuous introduction of hot water into sewers. This is a great, and at present almost unsuspected, source of danger. It is well known that certain diseases are only rampant when temperature continues above a certain point for a certain time. Thus yellow fever cannot get a footing in this country unless temperature has continued some time above seventy-five degrees. If sewers are kept at that temperature continuously by the discharge of hot water into them, it may be possible for the germs of yellow fever to find a resting-place, if they should perchance be introduced there. By analogy, it is possible that other diseases may be cultivated by raising the temperature of sewers. It is important, therefore, in the interest of the public health, that they should be kept as cool as possible. It is wrong, therefore, to allow of the continuous discharge of hot water from any source to be finding its way into sewers, and day after day keeping up the heat of those covered ways. I believe that it is possible for diphtheria and scarlatina to be cultivated in this manner, and to be spread abroad occasionally when there are concentrated discharges of sewer air, and that germs of those diseases would be dwarfed or destroyed if the sewers were kept cool. It is best for hot water to be well cooled before it is discharged into the drains.

I must not leave the subject of bathing without mentioning that there are dangers in the cold bath when injudiciously used: that delicate children of a certain type are unable to bear it, that they must be acclimatised to it by degrees. A child who is chilly after a bath, has been injured by it. A child who complains of feeling tired and seems to be suffering from a kind of malaise after bathing, must not be encouraged to remain in the water. This kind of case must be weeded out, so to speak, from the class, and should be gradually brought to bear the action. A rose-tree which has been kept in a hot-house will not bear a temperature of forty-five degrees at once, and yet a rose-tree which will not bear that temperature cannot be a healthy plant. It is the duty of school authorities to bring up a healthy class of children. Those which cannot bear a cold dip or cannot bear to be washed in cold water are not healthy. Measures should be taken to get rid of this inability. Fresh air is one of the means, and custom another. Children who are never washed all over, assist to damage the air of the schoolroom as well as their own persons. The pores are blocked by *debris*, and if the *debris* scales off it is the most efficient forcing-bed for the promulgation of infectious disease among other people, whilst if it remains on, it helps to make its owner more susceptible to epidemic influences. Thus on all hands it is important that the subject of baths and bathing should not be lost sight of.

The range of temperature for a cold bath should be from forty-five degrees to cold weather, to seventy-five degrees in summer. It is unwise to bathe in water colder than forty-five degrees. When it is below that degree, sponging the body in the bedroom quickly all over is the better plan. It is also dangerous to take a hot bath which is hotter than blood heat (98·5), unless with medical advice. Children who are washed every day with cold water, and who take a proper amount of exercise, will never really require a hot bath, provided the drying process is accompanied by a thoroughly good scrubbing.

Anecdotal Natural History.

No. V.—THE CAT TRIBE.

BY REV. J. G. WOOD, M.A., F.L.S.,

Author of 'Homes without Hands,' 'Nature's Teachings,' etc.,

AND THEODORE WOOD, M.E.S.,

Joint Author of 'The Field Naturalist's Handbook.'

PART I.

INCLUDED among the members of the cat tribe—or *Felidæ*, as they are scientifically termed—we find many of the largest and most powerful of all the *Carnivora*, or flesh-eating animals. The lordly lion, the fierce and savage tiger, the crafty leopard, and many others, all belong to this family, which, Australia excepted, is spread over the greater part of the world.

Intended by nature for an active and predacious existence, the structure of the Cats is pre-eminently adapted to suit their mode of life, and the whole form is a marvellous combination of strength, lightness, and activity.

Take the lion, for example. Who would think that an animal of such ponderous size and weight, who can strike an ox to the ground with a single blow of his mighty paw, could pass noiselessly through the thickest jungle and overtake an antelope in fair chase?

Let us now proceed to examine this wonderful structure in detail, and afterwards to devote a short space to each of the more prominent animals of the group.

We will first examine the skeleton, beginning with the skull.

Skeleton of Cat.

The first point which strikes the attention is the bony ridge which runs along the crest of the skull, and which chiefly serves as the attachment for the powerful muscles which act upon the jaws. Inside the skull a second ridge of bone is found, partly separating the two great divisions of the brain from one another. The object of this ridge has never been satisfactorily proved, but it is thought to be of service in guarding the brain from the severe shocks to which it might otherwise be subjected from the leaps and bounds of the animal.

The teeth of the cats, like those of all other exclusively flesh-eating animals, are formed for biting and tearing the prey alone, and not for masticating it before it is swallowed. None of them are found with the flat surface necessary for grinding the food, and even were such teeth possessed, the construction of the jaws would render impossible the side motion necessary for mastication. Upon watching a cat devouring her food, it will be seen that she bolts it in large lumps, swallowing it by a succession of sharp, pecking bites.

Passing to other parts of the skeleton, it will be noticed that the two first vertebræ are provided with a similar enlargement to that of the skull, for the better attachment of the muscles.

The bones of the limbs are of great strength, as is necessary for the rapid and powerful motions of the animals. The muscles are particularly hard and tough, seeming almost like ropes of iron, and turning the edge of the sharpest knives.

The claws, which are the chief weapons of the animal, are long, sharp, and strongly curved.

All the animals of the tribe being *digitigrades*, or those which walk upon the tips of the toes alone, it might be thought that the points of the claws would be constantly worn down by the friction with the ground, and thus rendered useless for purposes of offence.

In order to prevent this, there is a beautiful mechanism which, when the paw rests upon the ground,

Claw of Lion, sheathed.

withdraws the claws into the sheaths provided for them, and protects them from injury by the ground; as soon, however, as the paw is thrust forward to strike or grasp the prey, they are mechanically thrown out ready for use.

Claw of Lion, protruded.

Most people have had their hand licked by a favourite dog as a mark of affection, and know that his tongue is wet and smooth. Not so that of the cat, which is comparatively dry, and provided with a number of sharp, file-like points, pointing backwards, and serving to scrape every particle of flesh from the bones of a slaughtered animal.

So rough is the tongue of the domestic cat that it will cause pain to a delicate skin, while the larger animals of the tribe will draw blood almost immediately.

There is a well-known story of a gentleman who owned a pet lion, of which he was very fond, and with which he often indulged in a game of play. One day, whilst lying asleep upon a couch, the lion came up, and seeing one of his master's hands hanging outside the covering, began to lick it, just as a pet dog would under the circumstances.

In a short time the rough tongue cut through the skin and drew blood, which was greedily licked up by the animal, the pain at the same time awaking his master.

No sooner did he attempt to withdraw his hand than the creature uttered an angry growl, whereupon the gentleman, knowing the danger in which he was placed, and that a moment's hesitation might seal his fate, drew with his other hand a loaded pistol from beneath the pillow and shot his favourite through the head, as his only chance of escape.

All the feet of the cats are provided with soft, fleshy pads, which enable them to move noiselessly from place to place, and also serve to break the fall from the long leaps and bounds of the animals.

Another point to be noticed, too, is to be found in the whiskers.

These are provided at their roots with an extremely sensitive nerve, so that the slightest touch is at once felt by the animal. Those springing from the sides of the mouth, too, are of exactly the same width as the body, so that the animal is able to tell, even in the dark, whether it can pass through a narrow orifice or not.

Having now noticed the chief points of the structure of the cats, we will take each of the more important members of the family in their order, and examine their habits and mode of life.

To begin with, we will take the Lion (*Leo barbarus*), which stands at the head of the cat tribe—the acknowledged King of Beasts. No animal, and scarcely even man, can hear without trembling his mighty roar, and from his strength and courage he is feared by every denizen of the forest.

It is yet uncertain whether or not there is more than one species of lion. Some authors suppose the African lion, the Gambian lion, the Asiatic lion, etc., to be different animals; while others consider them to be merely varieties of the same type, slightly modified according to the country in which they live.

The most widely known of these species, or varieties, is the African lion, which is spread over the whole of the southern part of that continent, excepting those parts where civilised man has gained a permanent footing, and driven the wild beasts from his neighbourhood.

The lion, when it has spent its life free and untrammelled in its native haunts, attains to considerable dimensions, a full-grown animal averaging some four feet in height at the shoulder, and nearly eleven feet in total length from the nose to the tip of the tail. The lioness is rather less in size, and, owing to her want of mane, appears even smaller in comparison than is really the case.

The colour of the lion is a dark tawny yellow, deeper on the back, and lighter on the under parts of the body. The ears are blackish, and there is a thick tuft of hair at the end of the tail, found in no other member of the cat tribe, which is also black. The male lion, when it has attained the age of three or four years, is furnished with a shaggy mane of long hair, which falls from the neck and shoulders, and part of the throat. In the female this mane is wanting. It is remarkable that when young the lion bears dark stripes and spots on its fur, so that a well-marked specimen might easily be mistaken for a tiger-cat. A similar arrangement of colour is found in several animals, such as one or two species of swine, and the Malayan tapir.

There are various opinions as to the character of the lion.

Some hold him up as a model of generosity and courage, sparing the weak, but fighting the strong with the utmost courage. Other writers represent him as a mean, sneaking animal, afraid to face an armed man, and preferring to obtain his prey by stealth rather than by open warfare. Others, again, consider that his temper is uncertain, and that one day he will fight with great courage and ferocity, while on another he will fly in terror from a comparatively insignificant foe.

It is certain that the courage of even the same lion seems to vary at different times, and that on one occasion he will openly attack a number of armed men, while on another he takes refuge in flight before a single savage.

Like the rest of the cat tribe, the lion is of a very indolent nature except when suffering from the pangs of hunger, and, unless he be in want of a meal, will seldom take the trouble to fight.

Even when in pursuit of prey, he never takes more

exertion than is absolutely necessary for his purpose, but prefers to stalk the quarry until he can creep within five or six yards. One powerful bound and a single blow of his paw then suffices to kill his prey, and he earns his meal with very little active exertion.

Should the animal be of such size that the blow from his paw would be insufficient to kill it, the lion springs upon the flank or shoulder, and drags it to the ground by sheer strength, when it is easily despatched. A lion and his mate have been seen to spring upon a giraffe, and by their combined efforts to tear it to the ground.

Although the lion prefers living animals for his prey, he by no means disdains a repast from any carcase which he may find lying in his path. It is thought by several writers that many "man-eaters" acquire their taste for human flesh by preying upon the bodies of slain natives which they find in the bush.

If large game be scarce, he will satisfy his hunger by a meal on some of the smaller rodents, and has even been known to devour locusts and other insects in times of scarcity. If he should happen to suffer from thirst, too, when water cannot be procured, his instinct teaches him to search for the juicy water-melons which grow in the desert, and which answer the purpose of liquid nourishment to many animals, so that we have the remarkable fact of a carnivorous animal voluntarily taking to vegetable food.

The lion is justly dreaded by the colonists of southern Africa, for hardly a more determined foe to the farms could be found. Night after night he visits the enclosures, carrying off a valuable animal at each visit, and making his raids with such cunning and ingenuity, that it is generally a most difficult matter to trap or shoot him. Favoured by the darkness of the night, he creeps close to the folds, carefully watching for every sign of danger; as soon as he is satisfied that his presence is unnoticed, he leaps among the cattle, strikes one of the animals to the ground, and drags it off into the bush before the alarm is fairly given.

Travellers passing through the country with a train of horses and oxen, often lose a considerable quantity of stock by means of the lion's nocturnal visits. It is always the custom, at the approach of night, to tether the horses and oxen to the bushes, and making a large fire, to form an encampment around it.

The lion will prowl round and round within twenty or thirty yards of the camp, but dares not approach nearer on account of the fire. Finding that the cattle do not seem inclined to stray, he retires to a short distance, places his mouth close to the ground, and gives vent to two or three of his loudest roars. The oxen, alarmed by the terrible sounds, often break away from their tethers and rush out into the darkness, when the lion has no difficulty in making one of them his victim.

The most dreaded of all, however, is the terrible "man-eating" lion, which prowls in the neighbourhood of the villages, ready to pounce upon any unprotected human being who may pass within the vicinity of his lair. When once a lion has tasted human flesh, he prefers it to every other kind of food, and, daily growing bolder in his raids, causes a perfect panic in the neighbourhood. In such a case, the whole population of the village takes the field, and there is no rest until the dreaded man-eater is slain.

Several lions often band together in search of prey, and act in concert, each having his appointed part. In such a case, one of the lions drives the prey, generally a herd of elands, or other large animals, towards his companions, who lie in wait until the flying animals are within reach, when they fall an easy prey to their hidden foes.

Many stories of adventures with lions have been told, in some of which the lion has reversed the wished-for order of proceedings, and slain the hunter instead of being himself killed.

Even when mortally wounded, the animal generally has sufficient strength to throw himself upon his assailant, often killing or severely wounding him before succumbing in the death-struggle. In a few instances it has happened that a hunter has been carried off by a lion, and has yet escaped with comparatively slight injuries. The lion, like most of the cat tribe, when he has captured any animal, prefers to play with it for a short time before killing and eating it, just as our domestic cat amuses herself with a mouse, sometimes for hours, before putting an end to its miseries.

Knowing this habit, the hunter has remained perfectly quiet until the lion placed him on the ground, when, drawing a pistol or knife, he has contrived to shoot or stab his foe to the heart, and thus rescue himself from a horrible death.

Sometimes, as in the well-known case of the late Dr. Livingstone, it has happened that the lion has dallied with its prey long enough to permit the comrades of the fallen man to come to his rescue.

Men who have escaped in this manner always say that the first shake of the lion deprived them of all sense of fear and pain, and that they were then only conscious of a kind of languor, mixed with a wonder as to the way in which the lion intended to eat them.

It has often been noticed, in the case of a mouse caught by a cat, that even when released by its enemy it did not seem to attempt to save itself, but moved as though fascinated and unable to fly.

So we may conclude that the same merciful provision is made for the various animals upon which the carnivora feed, and that after the first shock little or no pain is felt.

Livingstone, who was once carried off by a lion, compares the sensation to that of a patient, partially under the influence of chloroform, who sees all the operation, but feels not the knife. "The shake," he says, "annihilated fear, and allowed no sense of horror in looking round at the beast. This peculiar state is probably produced in all animals killed by the carnivora; and, if so, is a merciful provision by our benevolent Creator for lessening the pain of death."

Even should a man succeed in making his escape from the clutches of a lion, and his wounds heal in due course, he is very unlikely to have entirely recovered from the effects of his injuries, for there seems to be a peculiar poisonous property about the lion's teeth, causing the wounds made by them to break out afresh every year about the time at which they were first inflicted.

The lion is an exceedingly cautious and wary animal, and will carefully avoid any object which it does not understand, or which bears the least resemblance to a trap.

Knowing these cautious habits, the hunters are accustomed to protect the carcase of a slaughtered animal,

which they are unable to carry away at the time, by fastening a streamer of white cloth to a stick, and planting it in the ground close by the animal. Or, a kind of clapper is constructed, which rattles in the wind, and which is planted in the same way. Although the lions will prowl in the neighbourhood all night, not one will dare to approach so mysterious an object, even though he may be half wild with hunger.

The young of the lion are generally from two to four in number, and are about the size of an ordinary tomcat. For the first few months of their life, the fur is brindled with darker stripes, in the same way as that of the tiger; as they grow older, however, these stripes gradually become fainter, and at last entirely disappear. The cubs are wonderfully playful little animals, and frisk and gambol about their mother just like so many kittens. Their weight is very great in proportion to their size, the skeleton and muscular systems being very solid and massive in structure. The full growth of the lion is not reached until the end of the fourth year.

In the more northern parts of Africa a variety, or species, of the lion is found, usually known as the Gambian lion (*Leo Gambianus*). In character and habits it differs only in the very slightest degree from its southern relative.

The lion which inhabits Asia presents no particular points of difference from that of Southern Africa, and a detailed description will therefore be unnecessary. A peculiar variety, or species, according to some writers, however, is found in Guzerat. This is usually known as the Maneless Lion (*Leo Goojrattensis*), on account of its lacking the hairy covering of the neck and shoulders which is found in the other species. This is not entirely wanting, but is very imperfectly developed, the animal not possessing, in consequence, the majestic aspect with which we are so familiar. The tail is shorter in comparison, with a large tuft of hair at the tip.

By the natives, this animal is often called the "camel-tiger," on account of the resemblance its fur bears in colour to that of the camel.

Like most of the members of the cat tribe, the lion has often been tamed as a pet, and learned to follow and obey its master just as does a dog. In these cases the animal has always been captured while quite a cub, before the wild and savage instincts of its nature had yet been implanted in its breast. It is commonly the case, too, to find a troop of performing lions in menageries and circuses. No matter how well trained the animals may be, however, it is always a dangerous performance, for a slight whim or a piece of ill-temper on the part of one of the animals may bring out all the savage nature of the beasts, and, before aid can be given, cause the death of the trainer, as has but too often happened.

Short Historical Anecdotes.

BY REV. SIR GEORGE W. COX, BART., M.A.

(25) Eunus and the Slave Revolt in Sicily.

MUCH is said about the spirit of freedom which animated the citizens of ancient Rome or Athens; but the only notion they had of citizenship was that of a body of men who could discharge the duties of citizens because all their work was done for them by slaves. If there were ten thousand citizens in either city, it was because a hundred thousand slaves lived and toiled and died, without comfort and without hope, to give them the leisure for a life of graceful refinement and of high political activity. As time went on, the yoke of the slave became unbearable, and the excessive multiplication of slaves led to revolt. The first great servile war broke out in Sicily in the latter half of the second century before the Christian Era. At the head of the slaves was one Eunus, who had made himself notorious by his claim to prophetical powers, and by exhibitions in which he breathed flames from his mouth. The outbreak began in the household of Damophilus, a man infamous for his wanton cruelty. The slaves put him and his wife to death, but showed their gratitude to his daughter, who had always treated them with kindness, by carefully shielding her from all harm. The slaves held their ground for two or three years against the Roman armies, and during this time maintained a thoroughly orderly government. According to modern law they were belligerents, and entitled to the rights of belligerents; but when at length Eunus and his followers were overthrown, all who were not slain in battle were doomed to death indiscriminately. No amount of forbearance and generosity shown through a series of months or years could obtain for them the least mercy from their former masters. The attempt to escape from thraldom was with them the unpardonable sin.

(26) The Slaves of Pedanius.

The better side of ancient slavery is exhibited to us in the Epistle of St. Paul to Philemon; but only a few months, or a year or two, before this letter was written, a Roman, named Pedanius, had been murdered by one of his slaves, whom his cruelty may have tortured into madness; and for the deed of this one man custom and law demanded that the whole household of slaves, or, as it was termed, the whole family should be put death. The innocence of the rest was beyond all doubt. No one questioned it; and amongst the people generally there was a dangerous excitement when the intention of so massacring them became known. The matter was brought before the Roman senate; and a large majority agreed that the filthy rabble of slaves, as they phrased it, could be kept down only by terror, and therefore that all of them, men, women, and little children must die. The populace was furious; but a legion of soldiers drove them from the streets, and between the hedges of their spears the victims marched to their graves. Such a fact may help us to understand in some degree what the state of things was with which the first teachers of Christianity had to deal.

(27) The Legend of the Monk Romanus.

The earliest Christian monks were, in the strictest sense, like all other monks, self-tormentors. For eight and-forty years from the summit of a pillar Simeon, hence called Stylites, edified the crowds who thronged around its base, not more by his preaching than by the wonderful skill with which he bent his forehead till it touched his feet. Simeon was a saint of the Eastern Church; but the austerity of the Western

monks was not a whit less severe. Some passed their lives in caverns, a prey to ecstasies and diabolical temptations. Another, discovered by shepherds on the crest of a rock, would not suffer them to approach him, but gave them his benediction as they knelt at the base of the cliff. In the heights of the Jura, Romanus found a lurking-place amidst impenetrable rocks and thickets, where he hoped that no human eye might see him. His brother Lupicinus found means to track him, and with him established the great monastery of Condat. On a neighbouring rock their sister governed five hundred women, who, once cloistered, never emerged except for burial. In this wild retreat all were satisfied but Lupicinus. His soul was vexed with the lightness of their austerities. Into one caldron he threw a meal of fish and vegetables which the monks were preparing separately with some neatness and care; and twelve of the brethren left the convent in indignation. 'Better were it for thee not to have come here,' said Romanus, 'than thus drive away our monks.' 'It matters not,' was the reply; 'it is the chaff separating itself from the wheat. God has no portion in them.'

(28) St. Columba and Iona.

The spirit of early Irish monachism is best shown, perhaps, in the story of the life and death of St. Columba. His birthplace was a rock; and the tale sprang up that for those who slept on that hard stone, banishment should lose something of its misery, and the memory of their native land should come back to them, not with the gnawing pain of home-sickness, but with the peaceful glow of a tender and consoling beauty. As to the calling of his life, Columba's mind was soon made up. 'I chose virginity and wisdom,' he said; and forthwith three beautiful maidens stood before him. His modesty shrank from the caresses which they were eager to lavish upon him. 'Know you not,' they asked, 'whose love and kisses you are throwing away? We are three sisters whom our Father has betrothed to thee.' 'But who is your Father?' 'He is the Lord Jesus Christ, the Saviour of the world.' 'I cannot deny the greatness of your lineage,' said Columba, 'but what are your names?' 'We are called Virginity, Wisdom, and Prophecy. We shall never leave thee, and ever love thee with a love which shall know no change.'

Not less beautiful is the picture which brings before us the closing scene of his life. The Saint had a blessing for all—for the grain stored up in the garner, for the old white horse which placed its head on its master's lap as he sat down on the great cross for the last time. Departing thence, he made his way slowly to the summit of the little hill whence his eye could range over the whole island of Iona, and there pronounced his benediction on his children and on all that they had, and foretold the greatness and the glories of his monastery in the time to come. Returning to his cell, he took up his habitual work of transcribing manuscripts. His fingers moved over the parchment until they had written the words, 'They who seek the Lord shall want no manner of thing that is good.' 'Here I must stop,' he said, 'Baithen will write the rest.' This faithful friend, who was to succeed him as abbot, supported him into the church, and remained with him afterwards in his cell. Through him he sent his last words to his dear children. They expressed a simple trust that a deep peace and a fervent charity might for ever reign among them. After this message the voice of Columba was heard no more; but when the midnight bell gave the signal for matins, the Saint arose, and hastening more rapidly than the brethren could follow him, entered the choir and prostrated himself before the altar. The building had not yet been lighted, and the monk who was nearest knew not in the darkness where he was. When others came with lights, they found him lying before the altar-steps. The monk, who had groped his way to his master, was supporting his head on his knees. Opening his eyes, Columba bestowed on all a glance full of a serene and radiant gladness, and, aided by Dermid, raised his hand for the act of benediction. Presently the muscles relaxed, and a faint sigh marked the moment when he fell asleep.

(29) Hannibal before the Walls of Rome.

The great task which Hannibal set himself was the humiliation of Rome. He failed to conquer the Eternal City; but once, and once only, he saw it. He had surmounted the stupendous Alpine barriers which sever Gaul from Italy. He had utterly destroyed the Roman army at the Thrasymene Lake, and again at Cannæ; and thenceforth no Roman general dared to meet him in the field. At length there seemed to be signs that Rome would be forsaken by her allies, and the revolt of Capua gave promise of further blows to be dealt upon his deadly enemy. But in fact the tide was turning against the great Carthaginian leader, and the Roman army which beleagured Capua never released its iron grip on the doomed town. Thus far Hannibal had thought that he could best do his work at a distance from Rome. Now he resolved to present himself before her walls. But he could not take the Romans unawares. Sixteen thousand men, perhaps more, detached from the army besieging Capua had reached Rome before him; and these, with the two legions already in the city, made Hannibal's project of storming its defences impossible. But with a few thousand Numidians he rode leisurely in front of the walls, no one daring to assail him. If we look only to what had passed, we might speak of it as his triumphal procession; but Hannibal knew that, though his career had been marked by an unbroken series of victories, Rome was still unconquered, and seeing that the Romans were steadily resolved not to leave their stronghold for the purpose of fighting him, he marched slowly southwards. The imagination of later times busied itself with devising incidents for this memorable visit. One story ran that on two successive days the Roman army was drawn up in order of battle before the forces of Hannibal, but that each day a storm drove them into their camps, the weather clearing up as soon as they were safely lodged within them. Another told how the ground on which Hannibal was encamped was, during the time of his occupation, put up to auction in Rome and bought at its full value. The story is at least more likely and less childish than the one which speaks of Hannibal as so vexed on hearing this news that he put up to auction in his camp the booths of the money-changers in the Roman Forum. It was enough that the great African general was baffled, and that there was no longer reason to fear that Carthage might become the mistress of the world.

Practical Lessons on Insect Life.

No. III.—THE ORDERS OF INSECTS.

BY THEODORE WOOD, M.E.S.,

Joint Author of 'The Field Naturalist's Handbook.'

IN order to facilitate the classification of Insects, they are divided into various groups, or *orders*, according to their differences of structure. Various systems have been employed by different authors, but the arrangement now about to be described is that generally in use at the present day, and which is based on the structure of the wings.

At the head of the insects stand the beetles, or *Coleoptera*, they being the most highly developed of the tribe. Their leading peculiarity is that of the four wings possessed by them: the upper pair are of a firm, horny nature, and are not used in flight, being merely employed to protect the lower pair, which are packed away beneath them. The name *Coleoptera* refers to this structure, being derived from two Greek words, the one signifying a sheath, and the other a wing—'sheath-wings.' When the insect is at rest these wing-cases, or *elytra* as they are more properly termed, do not overlap each other, but meet in a straight line continued for the whole, or nearly the whole, of their length. This line of junction is usually known as the suture.

The wings themselves are, when present, invariably larger than the elytra, and, when not in use, are folded transversely, and packed away beneath them. Many beetles, however, only possess the merest rudiments of wings, and in such cases the elytra are always soldered together. In one or two species both elytra and wings are almost entirely wanting.

The *Coleoptera* are provided with jaws, and subsist chiefly upon food of a solid nature.

As regards the earlier stages of development, the larvæ of the *Coleoptera* are soft, with the exception of the first two segments of the body. They are provided with six legs, corresponding with those of the perfect insect, and placed upon the same segments, namely, the second, third, and fourth. During the pupal state the insects of this order are inactive, and take no nourishment. The limbs are enclosed in the outer covering, just as is the case in the *Lepidoptera*.

Owing to the difficulty of watching the *Coleoptera* during the earlier stages of their life, the nature of their habits rendering it almost impossible to rear them in captivity, the life-histories of the order are but little known.

The next order consists of the *Euplexoptera*, or *Dermaptera* as they were formerly termed. The first of these titles is formed from three Greek words, signifying 'prettily-folded-wing,' the manner in which the lower pair of wings are packed away beneath the upper being simply marvellous. The older title, *Dermaptera*, signifying 'skin-winged,' referred to the structure of the elytra.

The insects composing the order are popularly known as earwigs, and are usually held in great detestation, partly on account of the pair of forceps with which the end of the body is provided, and partly owing to the prevalent idea that the creatures are in the habit of crawling into the human ear, reaching the brain, and driving the victim mad. In reality, the earwigs are perfectly harmless; for they possess no sting, they do *not* crawl into people's ears, and the tail-forceps, which are used in packing the wings beneath the elytra, are quite unable to inflict any injury upon the most delicate skin.

The earwigs were formerly included in the following order, the *Orthoptera*, but were separated on account of the manner in which the wings are folded.

In the *Orthoptera*—'straight-winged' insects—the upper wings, or elytra, are only partly horny, and are stretched upon strong nervures which supply the necessary rigidity. When not in use, these overlap each other, instead of merely meeting as is the case in the beetles. The hind wings are folded longitudinally, instead of transversely. The jaws are formed for cutting vegetable substances, upon which the greater number of these insects feed.

The larvæ and pupæ of the *Orthoptera* bear a very strong resemblance to the perfect insects, and outwardly seem only to differ with regard to the wings, which in the larva are entirely wanting, and in the pupa are only partly developed. Both larva and pupa are equally active with the perfect insect. The food is the same both in the preliminary and perfect stages.

The *Orthoptera* include the crickets, grasshoppers, and cockroaches of this country, and the leaf and walking-stick insects, etc., of abroad.

Next in order come the *Neuroptera*, or 'nerve-winged' insects, such as the dragon-flies, lace-wings, May-flies, etc. They are possessed of four transparent wings, equal, or nearly so, in size, and traversed by an intricate network of nervures, which are closely spread over the whole surface. The mouth is furnished with jaws.

Portion of a Wing of a Moth.

The larvæ of the *Neuroptera* are very different in appearance from the perfect insects, and are provided with the usual six jointed legs, each of which is terminated by a pair of strong claws. The pupæ often closely resemble the larvæ, and are sometimes active, and sometimes quiescent.

Next come the *Trichoptera*, or 'hairy-winged' insects, a small order comprising the well-known caddis-flies. These were formerly included among the *Neuroptera*, but were separated on account of the hairiness of the wings, and the mode of life of the larvæ, which reside in cases which they build of little twigs, empty shells, stones, straws, etc. When at rest, the lower pair of wings are folded beneath the upper, which are placed tent-wise longitudinally over the body.

Next follows the large and important order of the *Hymenoptera*, or 'membranous-winged' insects, comprising the bees, wasps, ants, ichneumons, etc. They are distinguished by possessing four transparent

wings, in which the nervures are more widely distributed than is the case in the *Neuroptera*. During flight, they are firmly fastened together by a row of small hooks, which are placed upon the inner margin of the hind wings, and which fit into a groove in the lower margin of the upper pair. In many of these insects it is almost impossible to detect the second pair of wings without close examination, the two pairs being so closely united that they appear like one.

The small hooks which unite the wings vary considerably both in size and form in different branches of the order, and are very well worth a careful examination beneath a tolerably high power of the microscope.

Among the *Hymenoptera* are included the only insects which possess stings, properly so-called, such as the bees, wasps, and hornets. Only the female insects possess these weapons, the males being perfectly harmless.

The sting is in reality nothing more than a modification of the ovipositor, provided with a poison-sac and duct. The poisonous fluid is secreted by two long and slight hair-like glands, one upon each side of the body, which lead into the poison-sac.

The larvæ of the *Hymenoptera* are usually soft, grub-like objects, entirely without the means of locomotion, and often requiring to be fed and tended by the adult insects. This is the case in the bees, wasps, hornets, and ants. The eggs of the various ichneumon-flies, however, are deposited within the bodies of living caterpillars, the young larvæ feeding upon the flesh of the unfortunate victim, and carefully avoiding the vital organs, until the time approaches for their involuntary host to change to the pupal condition. The 'stung' caterpillar then dies, and the parasites issue from its carcase in their perfect state, having undergone the whole of their preliminary stages in the body of their victim. The larvæ of the saw-flies differ from those of the rest of the *Hymenoptera* in being provided with legs. Of course, in these cases, the grubs are able to take care of themselves.

Libellula depressa.

The *Lepidoptera*, more commonly known as butterflies and moths, come next upon the list, and are, perhaps, the most widely known of all orders of insects. The name, *Lepidoptera*, is a very appropriate one, being derived from two Greek words signifying respectively a scale and a wing—'scale-winged' insects. Everybody is aware that if a butterfly or moth is roughly handled, a sort of coloured mealy substance is left upon the fingers, and the wing becomes transparent, like that of a fly, wherever it has been touched. If a small quantity of this mealy dust is placed beneath the microscope, it will be seen to consist of innumerable scales, of various sizes and shapes, glowing with all the colours of the rainbow and many more besides, and sculptured and chiselled in a most wonderful manner. It is to these scales that the *Lepidoptera* owe the colours and marking of their wings; for if they are rubbed off, the wings are seen to be formed of a simple, transparent membrane, as are those of a bee or gnat.

These scales are arranged upon the wings in rows, as may be seen in the accompanying illustration, which represents a portion of the wing of a moth under a high power of the microscope. The overlapping rows can be plainly seen, while in the part from which the scales have been removed a row of small dots denotes the position of their former roots.

There is a curious point about the development of these scales when the insect emerges from the pupal state. The wings are then folded and crumpled, and quite soft, not yet having been hardened by the air. The scales, however, are of their full size, and the rows are merely packed much more closely beneath each other than is the case when the wing is fully developed. As the wings are gradually spread to their full extent, the rows of scales are pushed forward from beneath each other, until the development is complete.

There is one family of moths in which the wings are almost entirely without scales, and in which the insects are consequently known as clear-wings.

Most of these moths bear a wonderful resemblance to certain *Hymenoptera*, such as the hornet, the gnat, the wasp, and so on, and are usually named after them. The likeness is often so great that even experienced entomologists sometimes find considerable difficulty in distinguishing between the two insects. Many a collector has been badly stung through mistaking the true hornet for the apparent, while at the same time he has allowed numbers of clear-wings to escape for fear of the stings which he supposed them to possess.

Another of the great distinctions in the *Lepidoptera* is found in the structure of the mouth.

The mandibles, or larger jaws, which are so strongly developed in the *Coleoptera* and other orders, in the butterflies and moths are almost rudimentary, and are not used by the insect in supplying itself with food. The *maxillæ*, or lesser jaws, however, are developed to a wonderful degree, and form a complete tube, which can be coiled away, when not in use, beneath the head. This tube, or *proboscis* as it is properly termed, can be separated into two portions, each answering to one of the maxillæ of which it is a development. The two parts are held together so as to form a tube, by a series of minute hooks, which, in spite of their small size, are of considerable strength.

Through this proboscis, liquid nourishment, which is the only form of food taken by the perfect *Lepidoptera*, is sucked up into the mouth.

The pupa is incapable of motion, and is enclosed in a semi-transparent horny case.

The *Lepidoptera* are usually divided into two great classes, namely, the *Rhopalocera*, or butterflies, and the *Heterocera*, or moths. The insects of the former

group are distinguished from those of the latter by their knobbed antennæ, and by the abdomen being considerably narrowed at its junction with the thorax. The wings, too, are never folded, but project boldly from the body.

Next in order come the *Homoptera*, or 'similar-winged' insects, so called from both the upper and under wings being constructed after the same fashion. All four wings are of a membranous character, and are all used in flight. The mouth is provided with a long, slender proboscis, not capable of being coiled like that of a butterfly or moth, by which the juices of plants are extracted to serve as food for the insects. There are never more than three joints in the *tarsus*, or foot.

The larvæ and pupæ closely resemble the perfect insects, only differing from them in the development of the wings. Aphides, and the insects which form the well-known 'cuckoo-spit,' and are commonly known as 'frog-hoppers,' besides many others, are included in the *Homoptera*.

The *Heteroptera*, or 'different-winged' insects, are the next on the list. The wings of those species which possess them in a perfectly developed state are horny near the base, the rest being membranous and transparent. The body is flattened, and the head is furnished with a proboscis, which starts from the front of the under surface of the head, and not from the back as is the case in the *Homoptera*. The larvæ and pupæ are similar to those of that order.

Many of the *Heteroptera* frequent the water, and others the land; the water-gnats, water-boatmen, water-scorpions, etc., among the former, and the 'bishop's mitres' and the too well-known bed-bug among the latter, being comprised in the order.

The *Homoptera* and *Heteroptera* are generally included under the one head of *Hemiptera*, or 'half-winged' insects, *i.e.*, those which have half of the wings membranous. The two groups are then known as *Hemiptera-homoptera* and *Hemiptera-heteroptera*.

A very large group of insects is the *Diptera*, or 'two-winged' flies, so called because the first pair of wings only is developed, the second being modified into a couple of small knobs, known as balancers, or, scientifically, *halteres*.

In such insects the *halteres* seem necessary to flight, for, should they be removed, the insect is unable to direct its course. At the base of the wings is generally found a pair of wing-like objects, or *alulets*, which are merely modifications of part of the upper pair.

The mouths of the *Diptera* are adapted for suction, and are often modified into weapons of offence, as is the case in the common gnat.

The preliminary stages of the growth vary considerably in different species, the larvæ and pupæ, however, generally being very distinct from each other.

The last order of insects is the *Aphaniptera*, or 'hidden-winged' insects, the wings being only rudimentary, and represented by four very minute scales upon the thorax. The insects of this order are popularly known as fleas.

The larvæ are small white grubs, and are entirely without legs, working their way along by means of a row of stiff bristles with which the margin of each segment is furnished.

It will thus be seen that the Insects are divided into eleven orders, of which the *Coleoptera*, *Hymenoptera*, *Hemiptera*, and *Diptera* are by far the most important. Of the first-named alone at least sixty-thousand species are known to exist, while large numbers, we may feel certain, are as yet undiscovered.

'How I Teach Elementary Science.'

FOURTH-SCHEDULE SUBJECTS: MECHANICS.

BY RICHARD BALCHIN.

WITH code upon code, and schedule following schedule, the elementary teacher may be pardoned if now and again he appears to more fortunate mortals to be well-nigh bewildered. If he can, however, manage to bring himself to a calm frame of mind, he may perhaps determine to study the Fourth Schedule of the Revised Code, and settle what special subjects he will take in Standards IV., V., and VI. He will find a list of them here, and he may, all on his own responsibility, choose one or two, not more. Thank you, my lords, for allowing thus much liberty for the play of our own several individualities. There are—first, the Literature subjects. These include English Composition and Poetry, Latin, German, and French. Second, Mathematics, by which is meant a little Euclid and more Algebra. Third, Science proper, which embraces Physiology, Botany, Mechanics, etc., and for girls Domestic Economy.

There are various considerations that will influence a teacher in making his choice. Some will study 'blue books' and 'reports,' and go round among their friends, exploring. This is for the purpose of ascertaining which subjects pay the best—*i.e.*, earn the most grant. This information gained, the whole question is settled. Others will look into their minds and memories to discover what two subjects they know most about without any further study; those two they teach, provided a decent grant may be anticipated. Others again have pet subjects for the time being. If those items are in the Schedule—and some of them may not be (Geology, for instance)—they are the ones selected. This last ground of choice is by no means a bad one. For a man will most likely teach best that subject upon which he has bestowed most of his attention.

But does it not strike the reader that, among all these considerations, the persons most interested, the very ones for whose benefit the Government framed this Fourth Schedule, are left entirely out of the reckoning? What as to the boys and girls themselves? Ought not the honest educator rather to ask himself, 'What are the subjects likely to be most useful to the children under my care—useful, I mean, in the direction of mental training, as well as of some practical application in the future concerns of their lives?' I am convinced that the one subject which best serves these two purposes is 'Mechanics.' There is this advantage also, connected with it. It is most logically and conveniently laid out in the three stages. And this is more than can be said of some of the other subjects—Botany, for instance. For the second subject, perhaps, on the whole, English Literature will be found to be the most profitable—I do not mean in a pecuniary sense. It is not that I set a very high estimate upon the repetition of the Poetry. The most valuable part of the subject is the 'letter-writing' and 'composition;' and for two reasons: first, it is a

good thing that boys should be trained to put their ideas and thoughts into the proper words and sentences. This gives a definiteness to their knowledge. 'Writing maketh an exact man.' It is good also for another reason. Unfortunately, as the present method of examination is wholly by written answers, and no part of it oral, as it should be, the examiner is able to judge of what the lads have been taught only by what they are able to put in writing. Now, a boy is a very innocent, humble, and artless creature, in at least this one respect. He never puts down upon his examination paper even one-tenth of what he knows, or has been ever so carefully taught; and he is not at all like those other creatures, older and more worldly, who on *their* examination papers, it may be in Science, make so great a show, and think to persuade the folks at South Kensington that their knowledge is indeed so profound that what appears upon their papers is evidently—and this must be quite clear to the examiner—but the smallest fraction of what they *could* say, only 'time was up.' I have never met with the boy, in Standards IV., V., or VI., who possessed this faculty of being able to impress upon the examiner the fact that he had vast stores of hidden knowledge.

'Unskilful he to note the card
Of prudent lore.'

In teaching Mechanics, don't put any of the little books at present published in the hands of the boys. None of them that I have read are of any use. I have one before me now that is said to have a tolerably wide circulation. The very first sentence in it is absurd and wrong. The writer defines 'matter' as being 'all that we can see, feel, hear, taste, smell, or touch, around us or in ourselves.' Now, while I am writing this, a bird is quite filling my garden with the sound of its sweet song. I can hear it. Is 'sound' matter? The sun is shining. Every place is full of its glorious heat. I feel the heat. Is 'heat' matter? Tyndal says heat is the name of a state or condition of matter; but Mr. Major says it is matter itself.

Let the teacher study the latest teachings of our greatest men of science; then make up a series of notes based upon the syllabus in the Schedule, and submit those notes to the Inspector at his visit. I have always done this, and have invariably found that the Inspectors have been quite satisfied; indeed, they have more than once told me that they infinitely prefer setting their questions from the teacher's own notes of the course of lessons he has himself arranged and given, than that he should bring out one of those wretched little twopenny books, and volunteer the information, 'This has been our text-book, sir.'

There is one matter in connection with Science teaching that I should like to impress upon my readers. Never teach anything as true which the boys, when they grow up, and read and think, will find out to be false. Many teachers seem to think that, in order to make some established scientific fact easy to the intelligences of boys, or prudent for the ears of parents and managers, it is necessary either to hide part of its truth, or to put something in its place which they think easier or more prudent to teach, but which, nevertheless, is not absolutely true. I have seen this done also by earnest teachers who want to make the scientific fact somehow fit in to their long-cherished theological ideas. My advice to such has always been, 'If you find that you are called upon to teach or explain a set of established facts, that do not seem to coincide with your previously-formed opinions, it is much better to refrain from the attempt to teach them at all, than to so attenuate or distort them that you not only teach but a small part of the truth, but run in danger of disseminating absolute falsehood. The new wine must be put into new skins, else not only may the old skins burst up, which matters little, but the new wine may be lost, which matters much.'

The first stage, mechanics, includes the following:—

1. Matter; its different states, and most striking physical properties.
2. Measures—*i.e.*, of time, space, and velocity.

This stage presents most excellent material for a year's course of good thought-awakening lessons. I have, however, never been able to get many boys in Standard IV. to pass the examination. This is, however, because of the difficulty such young children experience of committing their ideas to paper. If the examination were partly oral, most in this Standard would pass. Still the indirect results have been most valuable: that the direct ones have not been so too is more the fault of the method of examination than of the teacher.

The following is a detailed syllabus of the course of lessons, in this stage, that I have just completed.

1. Matter: material things, such as chalk, wood, water, gas, &c.; immaterial things, such as heat, sound, electricity. Definition of matter. Two lessons.
2. Elementary bodies. The elements: the chemical composition of chalk, air, water; with many experiments. Four lessons.
3. Particles, molecules, atoms. Two lessons.
4. Attraction of cohesion. One lesson.
5. Solids and fluids (liquids and gases). Six lessons.
6. Capillary attraction. Two lessons.
7. General ideas of attraction of gravitation. One lesson.
8. Properties of matter: tenacity and brittleness. Two lessons.
9. Further properties of matter: elasticity and flexibility, explained by reference to the attraction of cohesion. One lesson.
10. Further properties of matter: malleability and ductility. One lesson.
11. Further properties of matter: impenetrability and compressibility. One lesson.
12. Expansion of solids, liquids, and gases under heat. Six lessons.
13. Inertia and momentum. Two lessons.
14. The barometer and thermometer; their principle of action. Two lessons.
15. Measures generally. One lesson.
16. Measures of time. One lesson.
    Measures of space. One lesson.
    Measures of velocity. One lesson.
17. The production of a plane surface—*i.e.*, the use of the spirit-level and straight-edge.
18. The physical properties of water: expansion, contraction, boiling and freezing points; peculiar behaviour of water near the freezing-point. Six lessons.
19. Principle of action of a pair of bellows. One lesson.
20. Principle of action of the common pump. Two lessons.

Total number of lessons in the course, forty-five.

'A Talk about Language and Grammar.'

(*Continued from page* 179.)

BY MARTIN F. TUPPER, D.C.L., F.R.S.,
Author of 'Proverbial Philosophy,' etc.

O, SIMILARLY, and with the like particular reference to Greece and the oldest Latin writers, is the ruling letter of the second declension. In Greek, 'os' is the Latin 'us,' or according to those oldest writers, 'ous;' and the letter o will be found to pervade nearly every case both in Latin and Greek. U, with at least equal power, governs the fourth class: go through, 'gradus, cornu,' etc.

We thus see a reason for acquiescing in the Latin list of the five declensions; and, as a general rule, subject to exceptions, we may state that the nouns full of a and e are feminine; of i, all three genders; of o and u, masculine and neuter. Why the Latins should not have kept to the natural order of the vowels, it is not easy to conjecture, unless, indeed, as may fairly be suspected, the misarrangement is due to the errors of comparatively modern writers on grammar.

This familiar talk on a subject usually treated more severely is meant only as a desultory help to the more regular teaching to be found in other handbooks and school primers; being, by way of notes, explanatory and illustrative of the more formal treatises, serving as the adjective 'easy' to the substantive 'lesson.' Let these hints as to terms, rules, and difficulties, neglected to be explained by the rod-bearing ushers of a former era, help as they may the diligent young student at his drier, because sterner and more regular, studies in these happier days.

Let us now speak about the cases,—that is, the changes or accidents which befall nouns when trammelled in sentences. There is, first, the simple name or noun in the nominative case—as 'a knife;' next, if a noun possesses anything proper to its genus or nature, it is thrown into the possessive or genitive case—as 'the sharpness *of* a knife,' 'John's hand,' or 'the hand *of* John;' thirdly, if we give anything to a person or thing, such person or thing must be in the dative case, 'datus' in Latin meaning given—as 'John's hand gives sharpness *to* his knife;' fourthly, the next case is that of a noun which follows, and is operated on by the verb (that most active word in the sentence), and so is called in English the objective or accusative—as 'John has cut *his hand*;' the order being—nominative, verb, objective. In the learned languages, the cases of nouns are known at once by their endings or terminations, as we may see anon; but in most modern tongues the cases are indicated only by their places in the sentence, or by some characteristic preposition going before them. When I tell you that whole bookshelves may be filled with treatises on grammar, this little essay may claim excuse for not exhausting any part of it: the object here being solely to enable a young scholar to understand the technical terms of more complete and exact manuals of study; and we must be brief, as well as clear, in the little that can now be said.

The fifth case is named the Vocative, from 'voco,' I call,—vocal, being the one of calling,—as, 'Charles! come hither;' its sign with us, whether expressed or understood, being the interjection O! Sometimes in your Latin grammar you will find the word 'caret,' or 'is wanting,' to this case: not that it is really lacking to the noun, for one may call anything, but that it happens to be unchanged from the form of the nominative, and so it has come to be left out. In the old days when ushers explained nothing, this word 'caret' was an inscrutable mystery to small boys, as was also the greater part of the Eton Latin grammar, and especially so of the Greek. Similarly, from this cause of not changing from a former case, the 'ablative'—'ab' from, 'latus' taken—is commonly said to be wanting in several languages—for instance, in Greek, where it happens to be the same as the dative; so, too, with a large class of nouns in Latin; and in French, where the genitive serves for two purposes,—as 'de Londres' may mean of London, or from London; and the dative, as 'partoi,' etc. The ablative case, then, is the case or condition of the noun from which anything is taken, or by which anything is done—as 'I am cut *by* a knife,' 'I am prevented *from* going,' etc.

In English, the several cases are known by these simple prefixes:—First, or nominative, 'a' or 'the' in the singular, or the noun plural alone before the verb —'a man lives,' 'the house stands,' 'birds sing,' etc. Second, the genitive, by the word 'of' preceding, or ''s' (the short for his, possessive) following the word —as 'The hand *of* John'—John's—John his—hand. Third, the dative, by 'to,' expressed or understood—as 'Give me that,' 'give to me;' but the particle 'to' before a verb is not a preposition but a morsel of speech belonging to it, making it infinitive or undefined—as 'to be or not to be,' whereof more anon. Fourth, the accusative in English is chiefly known by following the verb—as 'A man built the house;' but in poetry (and sometimes also in prose, when writers of English think fit to imitate the Latins, without the possibility of being as clear as they are, because there is no change in the English word as there is in the Latin) it sometimes precedes the verb—as 'Arms and the man I sing.' Only a few words in our language change in the accusative—as 'he' to 'him,' 'she' to 'her,' etc.; but the want of a sign for our objective case is a weak point in English. Fifth, the vocative is known, as I have said, by the sign O expressed or understood, and often has after it a note of admiration, as it is called, indicating haste, or wonder, or shouting, and so forth. The sixth case is signalled by such prepositions as 'by,' 'with,' 'from, 'in,' and the like. All these things will show clearer when you come to 'parse' a sentence, or to take it *per se* by itself, as aforesaid.

I hope now that, in any English sentence, you will be able to tell the cases or conditions of its nouns: try; *I* (nom.) love *you* (acc.); Mary'*s* (gen.) *father* (nom.) wishes *her* (acc.) to learn; give *the horse* (dat.) *some corn* (acc.), *Charles* (voc.); take *the halter* (acc.) from *his head* (abl.), and so on.

It may be safest, now that we have come thus far in a desultory (that is to say, a jumping) fashion, to take your Latin grammar (for in learning this you learn English too) and shortly elucidate or make clear a few more of its mysteries in this familiar way; but taking less desultorily the regular order in which they occur—in effect, to fill up orally, or by the mouth of the teacher, what is involved or included in the written sentences of grammar.

(*To be continued.*)

'How I Teach Arithmetic.'

(*Continued from page* 174.)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

(*b*) The other lesson was as follows:—How much is $\frac{1}{2}$ of $\frac{3}{8}$? Find $\frac{4}{5}$ of $\frac{3}{4}$; $\frac{3}{5}$ of $\frac{12}{13}$; $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$; $\frac{5}{6}$ of $\frac{7}{9}$; $\frac{2}{3}$ of $3\frac{1}{5} = 2\frac{2}{15}$; $\frac{2}{15}$ of a £; $\frac{7}{15}$ of a £; $\frac{7}{16}$ of a £; $\frac{11}{32}$ of a £. Find $\frac{7}{10}$ of $8\frac{5}{6}, = 6\frac{11}{60}$. Here I would remark that, before beginning to work a question, especially on slates or on the board, I often give them a little time to look it over, so as to see and tell me somewhat approximately what the answer will be, as it is not an unheard-of circumstance for a thoughtless boy to bring out a result in which horses are $2\frac{1}{2}$d. each, or sugar £346, 15s. $8\frac{1}{2}$d. a lb. A boy to-day made a cask to hold nearly half a million gallons, and another in the lesson above (*a*) said that $\frac{2}{3} + \frac{5}{8} + \frac{7}{24} = 5$ and a fraction.

We now proceed,—$\frac{4}{11}$ of $10\frac{3}{8}$ is *about* what number? As $\frac{4}{11}$ is something more than $\frac{1}{3}$, the number will be a little over $\frac{1}{3}$ of $10\frac{3}{8}$; now $\frac{1}{3}$ of $10\frac{1}{2}$ would be $3\frac{1}{2}$, hence $\frac{1}{3}$ of $10\frac{3}{8}$ is nearly $3\frac{1}{2}$, and as $\frac{4}{11}$ is more than $\frac{1}{3}$, $\frac{4}{11}$ of $10\frac{3}{8}$ must be *about* 4. Find approximately $\frac{3}{7}$ of $19\frac{5}{6}$,—$\frac{1}{2}$ of $19\frac{5}{6}$ is very nearly 10, but $\frac{3}{7}$ is $\frac{1}{14}$ short of a half, hence $\frac{1}{14}$ of $19\frac{5}{6}$ (nearly $1\frac{1}{2}$) must be deducted from the 10, leaving the result *about* $8\frac{1}{2}$.

How much is $\frac{7}{8}$ of £2? Find $\frac{5}{8}$ of 3 guineas,—$\frac{1}{8}$ of a guinea = 2s. $7\frac{1}{2}$d., hence $\frac{1}{8}$ of 3 guineas = (2s. $7\frac{1}{2}$d. × 3) 7s. $10\frac{1}{2}$d., and $\frac{5}{8}$ = (7s. $10\frac{1}{2}$d. × 5) £1, 19s. $4\frac{1}{2}$d. Find $\frac{2}{3}$ of an hour; $\frac{4}{5}$ of $1\frac{1}{2}$ hours; $\frac{7}{12}$ of $3\frac{1}{2}$ hours.

Bring 3s. 9d. to fraction of a £; 4s. 9d. to fraction of a £; 6s. $10\frac{1}{2}$d. to fraction of a £,—here bringing both to three-halfpences, we have $\frac{55}{160} = \frac{11}{32}$. Bring $3\frac{1}{4}$ hours to fraction of a day; $7\frac{1}{4}$ hours to fraction of a day; 22 hours to the fraction of a week; 2 days 8 hours to fraction of a week.

A can mow an acre of grass in 8 hours and B in 6 hours, in what time can they together mow an acre?—Ans. $3\frac{3}{7}$ hours. Another,—A in 9 hours and B in 10 hours?—Ans. $4\frac{14}{19}$. Another,—A in 6 hours, B in 8, C in 10 hours?—$\frac{1}{6} + \frac{1}{8} + \frac{1}{10} = \frac{47}{120}$ fraction of an acre done in 1 hour; and as there are $\frac{120}{120}$ in the whole acre $(120 \div 47)$, the result is $2\frac{26}{47}$ hours. Another,—A in 5 hours, B in 6, C in 8 hours,—in what time can they together mow $1\frac{1}{2}$ acres?—$\frac{1}{5} + \frac{1}{6} + \frac{1}{8} = \frac{59}{120}$ acre in 1 hour, and as $1\frac{1}{2} = \frac{180}{120}$, then $180 \div 59 = 3\frac{3}{59}$ hours. Ans.

Bring $\frac{3}{8}$s. to fraction of a crown, $= \frac{3}{40}$. Bring $\frac{2}{9}$ guinea to fraction of a £. Here $\frac{2}{9} \times \frac{21}{20} = \frac{42}{180} = \frac{7}{30}$. Bring $\frac{2}{5}$ lb. to fraction of a stone (14 lb.), $= \frac{1}{35}$. Bring $\frac{3}{8}$ inch to fraction of a yard, $= \frac{1}{96}$.

Of what amount is 2s. $9\frac{1}{2}$d. the $\frac{2}{7}$ part? = 9s. $9\frac{3}{4}$d. Of what money is 5s. 5d. the $\frac{4}{9}$ part? = 12s. $2\frac{1}{4}$d.

Each of the above lessons occupied about half an hour, which is longer than usual for an *ordinary* lesson in mental arithmetic; but the above were not ordinary lessons, as they were especially confined to fractions. The above questions were mostly given orally, but several of the more difficult to remember were written on the board, as aids to the memory; they were all, however, worked out mentally, not a figure being made by the scholars during the lessons.

Having gone over the main, if not the whole, of the elementary operations required in manipulating fractions—(*a*) to (*m*), we will now work out fully a number of exercises and problems of a varied character, calling into requisition these elementary operations, and also making them the basis of any further explanatory remarks that may be required. I shall first work out a few examples from my own exercises in fractions.

(1) Add together the sum, difference, and product of $1\frac{1}{6}$ and $2\frac{3}{4}$. (No. 173.)

$$(1\tfrac{1}{6} + 2\tfrac{3}{4}) = (1\tfrac{2}{12} + 2\tfrac{9}{12}) = 3\tfrac{11}{12}, \text{ sum.}$$

$$2\tfrac{9}{12} - 1\tfrac{2}{12} = 1\tfrac{7}{12}, \text{ difference.}$$

$$(1\tfrac{1}{6} \times 2\tfrac{3}{4}) = (\tfrac{7}{6} \times \tfrac{11}{4}) = \tfrac{77}{24} = 3\tfrac{5}{24}, \text{ product.}$$

Then $3\frac{22}{24} + 1\frac{14}{24} + 3\frac{5}{24} = 7\frac{41}{24} = 8\frac{17}{24}$. Ans.

(2) Divide $\dfrac{7\frac{1}{7}}{8\frac{3}{4}}$ by $\dfrac{1\frac{1}{2}}{2\frac{3}{7}}$. (No. 189.)

$$\frac{7\frac{1}{7}}{8\frac{3}{4}} = \frac{7\frac{4}{28}}{8\frac{21}{28}} = \frac{200}{245} = \frac{40}{49}.$$

$$\frac{1\frac{1}{2}}{2\frac{3}{7}} = \frac{1\frac{7}{14}}{2\frac{6}{14}} = \frac{21}{34}.$$

$$(\tfrac{40}{49} \div \tfrac{21}{34}) = (\tfrac{40}{49} \times \tfrac{34}{21}) = \tfrac{1360}{1029} = 1\tfrac{331}{1029}. \text{ Ans.}$$

Here we have first simplified the fractions, and then divided in the usual method by inverting the divisor and multiplying.

(3) $\dfrac{8\frac{1}{4} - 5\frac{3}{8}}{9\frac{5}{6} \div 2\frac{1}{3}} \div \dfrac{7\frac{1}{2} + 3\frac{5}{16}}{4\frac{2}{3} \times 2\frac{8}{9}}$. (No. 249.)

$$8\tfrac{1}{4} - 5\tfrac{3}{8} = 2\tfrac{7}{8}.$$

$$(9\tfrac{5}{6} \div 2\tfrac{1}{3}) = \left(\frac{59}{{}_2\cancel{6}} \times \frac{\cancel{3}}{7}\right) = \tfrac{59}{14} = 4\tfrac{3}{14}.$$

$$\frac{2\frac{7}{8}}{4\frac{3}{14}} = \frac{2\frac{49}{56}}{4\frac{12}{56}} = \frac{161}{236}, \text{ first term simplified.}$$

$$(7\tfrac{1}{2} + 3\tfrac{5}{16}) = (7\tfrac{8}{16} + 3\tfrac{5}{16}) = 10\tfrac{13}{16}.$$

$$(4\tfrac{2}{3} \times 2\tfrac{8}{9}) = \tfrac{14}{3} \times \tfrac{26}{9} = \tfrac{364}{27} = 13\tfrac{13}{27}.$$

$$\frac{10\frac{13}{16}}{13\frac{13}{27}} = \frac{10\frac{351}{432}}{13\frac{208}{432}} = \frac{4671}{5824}, \text{ second term simplified.}$$

Then as the first term is to be divided by the second term,

$$\left(\frac{161}{236} \div \frac{4671}{5824}\right) = \left(\frac{161}{\underset{59}{\cancel{236}}} \times \frac{\overset{1456}{\cancel{5824}}}{4671}\right) = \frac{234416}{275589}. \text{ Ans.}$$

N.B.—This answer is in its lowest terms, but the worker to be quite sure that it is, ought to find its G. C. M. Four divides the two numbers that are cancelled above.

(4) How many coats, each requiring $2\frac{3}{16}$ yards, can be made out of $26\frac{1}{4}$ yards of cloth? (No. 55.)

Here first elicit what the number of coats will be approximately,—that there must be *about* 12; that as many times as $2\frac{3}{16}$ will go in $26\frac{1}{4}$ will be the number.

$2\frac{3}{16}$ = 35-sixteenths of a yard.

$26\frac{4}{16}$ = 420-sixteenths „

Then $420 \div 35 = 12$ coats. Ans.

(5) If a horse eats $10\frac{7}{8}$ lbs. of hay, and a cow $14\frac{5}{6}$ lbs. a day, how many days will a ton of hay serve 7 horses and 5 cows? (No. 127.)

Here first elicit from the scholars the distinctive steps that must be taken before commencing at all,—that we must (1) find how much the horses eat daily, (2) what the cows eat, (3) what they altogether eat daily, and then (4) how many times the number last obtained will go in 2240—the number of lbs. in a ton:—

$10\frac{7}{8}$ lbs. × 7 = $76\frac{1}{8}$ lbs.

$14\frac{5}{6}$ lbs. × 5 = $74\frac{1}{6}$ „

$\underline{150\frac{7}{24}} = \frac{3607}{24}$.

2240 lbs. × 24 = $\frac{53760}{24}$.

Hence $53760 \div 3607 = 14\frac{3262}{3607}$ days. Ans.

(6) A person ignorant of fractions left by will £4264 to be divided among his three sons, so that they should receive $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ respectively; what amount should each receive in order to carry out equitably the father's intentions? (No. 248.)

First show clearly that if $\frac{1}{2}$ and $\frac{1}{3}$ were taken from a whole one, there would not be $\frac{1}{4}$ left,—that these three fractions are above a whole one, and that to carry out literally what is expressed is impossible;—$(\frac{1}{2}+\frac{1}{3}+\frac{1}{4})=(\frac{6}{12}+\frac{4}{12}+\frac{3}{12})=\frac{13}{12}$ instead of 12-twelfths. Hence, instead of dividing the money into 12 parts, we must divide it into 13, giving them respectively 6, 4, and 3 of these parts—*thirteenths*.

$\frac{1}{13}$ of £4264 = £328.

$$\text{Then } \left.\begin{array}{l} £328 \times 6 = £1968. \\ £328 \times 4 = £1312. \\ £328 \times 3 = £984. \end{array}\right\} \text{Ans.}$$

(7) A can make a coat in $22\frac{2}{9}$ hours,—he works at it alone for $10\frac{1}{4}$ hours and then B assists him to finish it, which they do in $5\frac{1}{3}$ hours more;—in what time could B make the coat alone? (No. 272.)

(*a*) $\frac{10\frac{1}{4}}{22\frac{2}{9}}=\frac{10\frac{9}{36}}{22\frac{8}{36}}=\frac{369}{800}$, part done by A alone;

(*b*) $\frac{800}{800}-\frac{369}{800}=\frac{431}{800}$, part to be done by A and B together in $5\frac{1}{3}$ hours;

(*c*) $\frac{5\frac{1}{3}}{22\frac{2}{9}}=\frac{5\frac{3}{9}}{22\frac{2}{9}}=\frac{48}{200}=\frac{192}{800}$, part done by A in the $5\frac{1}{3}$ hours;

(*d*) $\frac{431}{800}-\frac{192}{800}=\frac{239}{800}$, part done by B in the $5\frac{1}{3}$ hours;

(*e*) $(\frac{239}{800}\div 5\frac{1}{3})=(\frac{239}{800}\times\frac{3}{16})=\frac{717}{12800}$, part done by B in 1 hour;

(*f*) $12800\div 717=17\frac{611}{717}$ hours. Ans.

Each of the above steps seems so natural that we need not occupy more space by attempting further elucidation.

(8) If 3 horses are worth 5 oxen, and 2 oxen worth 11 sheep, find the aggregate value of one of each, supposing a horse to be worth 5 guineas more than an ox. (No. 237.)

In working out this question for those who have read it over several times, but who fail to find a vulnerable point which to attack, I proceed thus:—3 horses are worth 5 oxen, then 1 horse is worth $1\frac{2}{3}$ oxen; but a horse is worth an ox plus 5 guineas, that is, put distinctly, a horse is worth 1 ox + $\frac{2}{3}$ ox, or it is worth 1 ox + 5 guineas; hence $\frac{2}{3}$ of an ox must be worth 5 guineas. The question now presents little difficulty:—

	£	s.	d.
(£5, 5s. 0d. ÷ 2) × 3 =	7	17	6, an ox.
£7, 17s. 6d. + £5, 5s. 0d. =	13	2	6, a horse.
(£7, 17s. 6d. × 2) ÷ 11 =	1	8	$7\frac{7}{11}$, a sheep.
	£22	8	$7\frac{7}{11}$. Ans.

We will now work a few questions from Colenso's *Arithmetic*.

(9) A ship is worth £16000, and a person possessed of $\frac{5}{16}$ of it sells $\frac{3}{8}$ of his share; what share has he remaining, and what is it worth? (No. 40, Art. 36.)

As he sells $\frac{3}{8}$ of his share, he has $\frac{5}{8}$ of it (his share) left; and as his share was $\frac{5}{16}$, he has $\frac{5}{8}$ of $\frac{5}{16}=\frac{25}{128}$, the *share* of the ship he still holds. The whole ship being worth £16000, $\frac{1}{16}$ must be worth £1000, and $\frac{5}{16}$ worth £5000, the value of the share originally held. He still holds $\frac{5}{8}$ of the original share, hence (£5000 ÷ 8) × 5 = £3125, *value* still held. Or it may be worked more succinctly thus:—

$\frac{8}{8}-\frac{3}{8}=\frac{5}{8}$, fraction of *share* still held.
$\frac{5}{8}$ of $\frac{5}{16}=\frac{25}{128}$, fraction of *ship* still held.
$\frac{5}{16}$ of £16000 = £5000, value of original share.
$\frac{5}{8}$ of £5000 = £3125, „ share still held.

(10) How many yards of paper, $\frac{5}{8}$ yard wide, will be required for the walls of a room that is $20\frac{3}{8}$ feet long by $11\frac{1}{5}$ feet wide, and $12\frac{1}{2}$ feet high? and what will be the cost of it at $2\frac{1}{4}$d. a yard? (No. 48, Art. 36.)

This question presumes a little knowledge of Mensuration, to the extent of knowing how to find the area of a rectangle, on the part of the learner. This requirement is not very unreasonable in a scholar who is to be examined in Fractions—that is, in the Sixth Standard—although there it is beyond the letter of the Code; but such questions are decidedly beyond the requirements of the *Fourth* Standard, some Inspectors' cards for examining which I have heard of, and also seen with my own eyes, to contain such questions as the following:—'How many square inches in a door $6\frac{1}{2}$ feet long and $3\frac{3}{4}$ feet broad?' 'How many square yards are there in a floor $60\frac{1}{2}$ feet long and 27 feet broad?' Were such requirements expressed in the Code, there would be no very great difficulty in providing for such questions, but to spring on a child unexpectedly seems somewhat unfair. To return to our question, if the scholars do not know how to find the area of a rectangle, now explain the principle of operation and educe the rule. Thus, a piece of paper 4 inches long and 1 inch broad contains 4 square inches, 4 long and 2 broad contains 8, 6 long and 3 broad contains 18 square inches, etc. Illustrate on the board by dividing spaces of these and other dimensions into square inches, then educe the rule that we find the area of any rectangle by simply multiplying the length by the breadth. Now explain that we have four walls to paper, and that they will take just the same quantity of paper as if all the walls were in one straight line. As the two sides are of equal length, and the two ends of equal length, we have $(20\frac{3}{8}\times 2)+(11\frac{1}{5}\times 2)=40\frac{3}{4}+22\frac{2}{5}=63\frac{3}{20}$ feet, the perimeter of the room, or length of all the walls;

then $(63\frac{3}{20}\times 12\frac{1}{2})=\frac{1263}{\cancel{20}\,4}\times\frac{\overset{5}{\cancel{25}}}{2}=\frac{6315}{8}=789\frac{3}{8}$ sq. feet,

the area of the walls, or of paper required. The paper being $\frac{5}{8}$ yard wide, a yard of it will be $\frac{5}{8}$ of a sq. yd. = $\frac{5}{8}$ of 9 sq. ft. = $5\frac{5}{8}$ sq. ft. Then as 1 yard of paper covers $5\frac{5}{8}$ square feet, $(789\frac{3}{8}\div 5\frac{5}{8})=\left(\frac{6315}{\cancel{8}}\times\frac{\cancel{8}}{45}\right)$ $=6315\div 45=140\frac{1}{3}$ yards of paper required. And $(140\frac{1}{3}\times 2\frac{1}{4})=(280\frac{2}{3}+35\frac{1}{12})=315\frac{3}{4}$d. = £1, 6s. $3\frac{3}{4}$d. Ans.

Expressed more concisely, the working is:—

$(20\frac{3}{8}\times 2)+(11\frac{1}{5}+2)=63\frac{3}{20}$ ft., walls' length.
$63\frac{3}{20}\times 12\frac{1}{2}=789\frac{3}{8}$ sq. ft. of paper.
$\frac{5}{8}$ of 9 sq. ft. = $5\frac{5}{8}$ sq. ft. in a yard.
$789\frac{3}{8}\div 5\frac{5}{8}=140\frac{1}{3}$ yards. Ans.
$140\frac{1}{3}\times 2\frac{1}{4}=315\frac{3}{4}$d. = £1, 6s. $3\frac{3}{4}$d. Ans.

(To be continued.)

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set*].

Arithmetic.

STANDARD I.

(1) From nine hundred and four take three hundred and eighty-six. Ans. 518.

(2) Add up six hundred and nineteen, eight hundred and four, ninety-six, five hundred and thirty-eight, seven hundred and six, and nine hundred and ninety. Ans. 3,753.

(3) Take sixty-five from three hundred and twenty. Ans. 255.

Dictation Exercise.

nail	**jam**	**door**
punch	**hammer**	**nose**

STANDARD II.

(1) Take sixty-five thousand seven hundred and seventeen from eighty-two thousand three hundred and three. Ans. 16,586.

(2) Divide seventy-one thousand three hundred and four, by nine. Ans. 7,922 + 6.

(3) Multiply nine thousand two hundred and seventy-nine, by eighty-five. Ans. 9,279.

(4) Divide sixty-nine thousand and seventy-four, by seven. Ans. 9,867 + 5.

STANDARD III.

(1) Write in words, 30,100,012. Ans. thirty millions, one hundred thousand and twelve.

(2) Divide three hundred and eighty-three thousand nine hundred and ninety-four, by eighty-nine. Ans. 4,314 + 48.

(3) Find the sum of four shillings and sixpence farthing, forty-eight pounds nineteen shillings and elevenpence farthing, fifty-six pounds ten shillings and eightpence three farthings, and sixteen pounds eighteen shillings. Ans. £122 13s. 2¼d.

(4) How much must be added to eighteen thousand and eleven pounds six shillings and ninepence to make twenty thousand pounds? Ans. £1988 13s. 3d.

STANDARD IV.

(1) Multiply six hundred and eight pounds ten shillings and tenpence three farthings, by one hundred and ninety-nine. Ans. £121,100 8s. 3¼d.

(2) Divide four hundred and eighteen thousand and seventy-six pounds nineteen shillings and a penny, by two thousand one hundred and ninety-six. Ans. £190 7s. 7¼d. + 1936.

(3) Reduce seven hundred and sixteen thousand nine hundred and forty-two grains to pounds (Troy). Ans. 124 lbs. 5 ozs. 12 dwts. 14 grs.

(4) How much does a man run in debt who earns eight hundred and thirty-four pounds eighteen shillings and sevenpence halfpenny, and spends eight hundred and twenty-one guineas? Ans. £27 2s. 4½d.

STANDARD V.

(1) Find the value of eight thousand and forty-nine articles at fifteen pounds fourteen shillings and tenpence halfpenny each. Ans. £126,721 8s. 10½d.

(2) What will 2 tons 9 cwt. 1 qr. 11 lbs. cost at one pound twelve shillings and eightpence per cwt.? Ans. £80 12s. 0½d.

(3) If the yearly rent of a cottage is eight pounds thirteen shillings and fourpence, what would the rent be for seventeen weeks? Ans. £2 16s. 8d.

(4) Make out the following corn-factor's bill:—12 stones of flour at 2s. 5d. per stone; 2 cwt. 1 qr. oatmeal at 16s. 7d. per cwt.; 5½ bushels of peas at 15s. 3d. per bushel; and 1 qr. 2 bushels Indian corn at 1s. 6d. per bushel.

	£	s.	d.
Ans.	1	10	0
	1	17	3¾
	4	3	10½
	0	15	0
	£8	6	2¼

STANDARD VI.

(1) Reduce three-quarters of a yard to the fraction of a mile. Ans. $\frac{3}{7040}$.

(2) What is the difference between one-eighth of nine pounds eleven shillings and tenpence, and one-sixth of ten pounds three shillings and tenpence halfpenny? Ans. 10s.

(3) If twelve horses plough a field of twelve acres in thirty days, how many horses will plough a field of thirty-nine acres in nine days? Ans. 130.

(4) Divide 36 by ·0081. Ans. 4444·$\dot{4}$.

Grammar.

STANDARD IV.

Parse, The poor boy quickly put the old woman's money into his pocket.

STANDARD V.

Parse and Analyse, Squirrels during summer store up a quantity of nuts in some safe place for winter use.

STANDARD VI.

(*a*) Parse and Analyse, If you examine a large sheet of common glass you will see that it has a thick round mark in the centre.

(*b*) Write a short essay on 'Summer.'

Geography.

(1) Describe the shape of the earth, and its motion.

(2) Name the oceans and continents of the world.

(3) Name the chief countries of Europe, and the capital of each.

(4) Name the chief seaports of England, and mention the counties in which they are situated.

(5) Describe the course of the Thames, Severn, and the Mersey.

(6) Describe a journey from London to Calcutta.

THE BLACKSMITH'S SHOP.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.

The Practical Teacher.

A MONTHLY EDUCATIONAL JOURNAL.

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The Editor cannot return rejected MSS.; authors should therefore retain copies.

IMPORTANT NOTICE.

THE August and September issue (Nos. 6 and 7) of the *Practical Teacher* will contain the Scholarship Questions, July, 1881, with model answers to every question in every subject. *Early orders should be given to the Booksellers.*

☞ **In reply to numerous inquiries, the Editor begs to state that a Series of Papers of special interest to Schoolmistresses will shortly appear in this journal. The first will be entitled 'How I Teach Needlework.'**

Monthly Notes.

WESTMINSTER WESLEYAN COLLEGE.—All Westminster students will be pleased to hear that Mr. Mansford has been appointed *Vice-Principal* of their *alma-mater*. Mr. Mansford was born in the year 1833, and in his youth attended the Wesleyan School at Lincoln. In 1848 he became a pupil-teacher under Mr. Holton, and at the expiration of his apprenticeship entered the above College in the autumn of 1852. His rare mathematical acquirements attracted the notice of the college authorities, and at Christmas, 1853, he was retained on the staff as mathematical tutor. In October, 1857, he graduated, B.A. at the London University, and on the death of Mr. Pickard, was appointed, in January, 1867, resident superintendent. Few men are so well fitted to occupy this new post as Mr. Mansford. His high moral and intellectual character, his uniform courtesy and consideration for the best welfare of the students, his simple, clear, logical style as a lecturer, and his admirable administrative ability, all combine to make the choice a particularly happy one. We congratulate the College on having secured so excellent a Vice-Principal.

THE EDUCATION CODE.—On the 23rd May a deputation from the Conference on Code Reform, which was recently held at the offices of the London School Board, had an interview with Earl Spencer and Mr. Mundella at the Privy Council Office, for the purpose of presenting the memorial on the defective working of the present Code which was drawn up by the Conference. After the presentation of the memorial (the full text of which has already appeared in these columns), Mr. Mundella said that the recommendations of the deputation were based on scientific improvement, and would afford the Privy Council valuable aid. In the first place they must consider the low standard of education which satisfied the great majority of English people, the short school-hours of the children, and the fact that the majority of children passed out of school when they passed the Fourth Standard. The recommendations of the deputation might be admirably fitted for Switzerland or Germany, where the children went to school at six years of age, and continued there regularly till fourteen years of age; and if they failed to pass through the classes at that age, they were made to attend up to sixteen years of age or later, until they had completed their curriculum. The state of things in this country was very different. It appeared to him that they would have to adapt our Code so as to meet the case of children who passed out to labour at the Fourth Standard. It was far better that what was done should be thoroughly done, than attempt too much, and not have it performed efficiently. He hoped, with the aid of gentlemen like those before him, to succeed in bringing out a Code that would be worthy of the country, and would not only quicken the education in large towns, but in every village school and more ambitious schools throughout the kingdom.

SPELLING REFORM.—The second annual meeting of the English Spelling Reform Association was held on the 26th May, in the rooms of the Royal Asiatic Society, Albemarle Street. The chair was taken by Professor A. H. Sayce, the President of the society, who, in moving the adoption of the Report, said that the first and most important work to be done in spelling reform was to destroy, not to construct; to persuade people that the present system was bad, and that the adoption of one of the suggested improvements would not make English literature a sealed book to the mass of readers. The proposed reform was one which had encountered ridicule, but it had now become a question of the day, and had obtained the support of the leading scientific men of England and America. The Report, which recommended a petition to the Educational Department urging that facilities should be given in public elementary schools to introduce improved methods of teaching reading, was carried.

ROYAL GEOGRAPHICAL SOCIETY.—The anniversary meeting of the Royal Geographical Society was held on May 23rd, in the Hall of the University of London, the Right Hon. Lord Aberdare presiding. After the reading of the Report, the President announced that the Royal Founder's Medal would be awarded to Major Serpa Pinto, for his remarkable journey across Africa, from Benguela to Natal, during which he had traversed nearly 500 miles of new country, and had explored with simple daring and great courage a dangerous region, and had made a series of astronomical observations. The medal was then handed to the representative of Major Serpa Pinto, who was not present in person. Other medals were presented to Mr. B. L. Smith for his important discoveries in Franz Josef Land, and to four boys from the chief public schools. Lord Aberdare, having been re-elected President, proceeded to deliver his presidential address, and, speaking of the discoveries which had been made in Africa, said that there still remained a great belt of country, watered by the Lualaba and its tributaries, said to be studded with great lakes, untrodden by the European explorer.

TRAINING OF THE DEAF.—The annual meeting of the Society for Training Teachers of the Deaf on the Oral System, was held on the 26th May, at the College, Castle Hill, Ealing; Major-General F. C. Cotton in the chair. The Report, which commented on the fact that there was a growing appreciation in the country of the oral system, stated that the premises at Ealing had become far too small for the requirements of the College, and the Committee, in consequence, had determined to seek additional accommodation, either by purchasing the present site and enlarging the building now on it, or acquiring suitable premises elsewhere. After the reading of the Report, the examination of the pupils was proceeded with, in the presence of a large company of ladies and gentlemen, who manifested great interest in the proceedings. The pupils examined exhibited very satisfactory progress, and answered various questions with great readiness. At the close, resolutions were passed expressing satisfaction with the proceedings, and a hope that the benefit of speech may be widely extended to deaf children, and pledging the meeting to do its utmost to raise the £5,000 required for the enlargement of the buildings.

VICTORIA UNIVERSITY.—In the first examinations of the new Victoria University, which are to be held very shortly, the following examiners will take part:—In classics, Rev. R. Burn; mathematics, Dr. J. Hopkinson; physics and chemistry, Prof. Rucker; history and law, Prof. Bryce; philosophy, Prof. G. C. Robertson; biology, Dr. M. Foster. The complete scheme of regulations is now being printed.

DOMESTIC ECONOMY CONGRESS.—Her Royal Highness the Princess Christian, President of the Domestic Economy Congress, took the chair at the meeting of the Ladies' General Committee held on the 1st June, at the Society of Arts. Amongst those present were the Countess of Airlie, the Countess Spencer, Viscountess Strangford, Lady Marion Alford, Lady Jane Stewart, etc. After the formal business had been gone through, Her Royal Highness inspected the needlework of a public elementary school, executed in the presence of one of the inspectors.

REFORMATORY AND INDUSTRIAL SCHOOLS.—In the House of Lords, on the 30th May, Lord Norton called attention to the laws relating to reformatory and industrial education of children, intimating that he thought it more desirable that punishment for crime should be a treatment separate from general education, and stating that if the Government did not take the matter in hand, he would ask leave to bring in a bill on the subject. After some discussion, in which Lords Houghton and Aberdare and the Earl of Carnarvon took part, the Earl of Dalhousie said that while the Government could not accept the resolutions of Lord Norton, they certainly intended carrying out some reforms. Lord Norton then withdrew his motion.

NOTICE OF REMOVAL.—We are requested to state that Messrs. Bates, Hendy, & Co., who have been for sixteen years at 4, Old Jewry, have removed their British, Foreign, and Colonial Newspaper Offices to 37, Walbrook, E.C., where all communications should in future be addressed.

CHURCH SCHOOLMASTERS AND SCHOOLMISTRESSES' BENEVOLENT INSTITUTION.—The Archbishop of Canterbury presided on the 28th May at the annual meeting of the members and friends of the above Institution, held in the grounds of Lambeth Palace, the library, in which the meeting was to have taken place, being insufficient to accommodate the large number who attended. The annual sermon which is preached on behalf of the society was delivered at a special service held previous to the meeting, at St. Mary's Church, by the Rev. Canon Fleming, B.D., Chaplain to the Lord Mayor. The objects of this Institution are, in the first place, to afford relief to teachers of public elementary schools, together with assistance to their widows and orphans in times of temporary distress; to provide small annuities for aged and afflicted teachers permanently disabled from following their vocation and having no sufficient resource; and to assist in the education and maintenance of teachers' orphans until fourteen years of age. Upwards of £7,500 has been granted in the relief of numerous cases of temporary distress among teachers and their families. One hundred and eighty-two disabled teachers have been elected to annuities, in which over £11,000 has been paid, and to secure the continuance of which £12,000 has been invested in approved securities. One hundred and six teachers' orphans have also been elected to continuous home allowances until attaining the age of fourteen years, and twenty more are to be added shortly. His Grace the Archbishop of Canterbury, in opening the proceedings, paid a high tribute to the work of the teachers, and adverted to the importance of the work in which they were engaged. After speeches by the Rt. Hon. W. H. Smith, M.P., Rev. Canon Gover, and others, the meeting terminated.

THE TONIC SOL-FA COLLEGE.—The annual meeting in connection with this institution was held on the 30th May at Exeter Hall; Sir H. Cole, K.C.B., in the chair. From the report which was submitted by the Secretary, it appears that the College, which has been incorporated six years, is now nearly self-sustaining. During the past year 10,936 certificates have been granted, and it is computed that in the winter months

200,000 pupils receive instruction in the Tonic Sol-Fa method. The chairman, in addressing the meeting, said that the Tonic Sol-Fa system was by far the best method for introducing music into the United Kingdom, and he prophesied that it would be used universally in the schools of the country, and that its introduction would be the first step in the national cultivation of music.

SCIENTIFIC EDUCATION.—A memorial to Earl Spencer, Mr. Mundella, and the Committee of Council on Education, is now in course of signature, urging the more systematic teaching of science in elementary schools. The suggestions are made in prospect of the fundamental changes which are contemplated in the Code. The memorialists urge that in Standards I., II., and III., systematic object-lessons should be given which would lead up to the more scientific teaching to be required in the higher Standards. The memorial has been signed by Professor Max Müller, Dr. Caldicott, Mr. Eve, Professor Meiklejohn, Professor Carey Foster, and many leading members of various School Boards.

THE EARL OF SHAFTESBURY ON RAGGED SCHOOLS. —The thirty-ninth annual meeting of Field Lane Refuge and Ragged School, Clerkenwell, was held on June 16th, under the presidency of the Earl of Shaftesbury, K.G. After the reading of the report, from which it appeared that the institution was in a prosperous condition, the noble chairman said that in Field Lane the Ragged School movement originated, and it had taught the public that it was the only system which could reach the seething mass of ignorance, destitution, and filth that existed in great cities. State-aided education was incapable of reaching the destitute, neglected, and wandering. The Ragged School system endeavoured to supplement, as far as possible, the deficiency of paternal care, and he would rather be at the head of such a movement than president of the Royal Society. Ragged Schools, he maintained, had greatly tended to the maintenance of order, decency, and propriety in the metropolis. Amongst the other speakers who urged the claims of the institution were the Bishop of Bedford, the Rev. Gordon Calthrop, and the Hon. A. F. Kinnaird.

THAMES VALLEY TEACHERS' ASSOCIATION.—A general meeting of the members of the above Association was held at Earl Russell's Schools, Petersham Park, Richmond, on Saturday, June 11th, 1881. The minutes of the previous meeting were read and confirmed. A vote of condolence with the widow and family of the late Mr. Alfred Legg, of the Public Schools, Kingston, was passed amid many expressions of regret for his early decease. Letters were read from Lord George Hamilton and other M.P.'s respecting the Registration Bill, and Messrs. Martin, Stone, Diprose, and E. Wilkes Smith gave an account of the Conference proceedings. After the tea, to which sixty-eight sat down, J. R. Langler, Esq., B.A., President of the N.U.E.T., delivered an able address to the teachers present on the advantages of union, the work of the executive, the coming code, and the necessity for a high moral tone in the educator. On the motion of Mr. Pillinger, seconded by Mr. Stevens, a hearty vote of thanks was accorded to Mr. Langler for his kindness in attending, and for his able address. The meeting then adjourned to the park for cricket, etc.

We are pleased to state that Mr. Thomas Laurie, formerly of Stationers' Hall Court, has removed to more commodious premises at 31, Paternoster Row, E.C.

—o—

Gossip.

The following new publications will shortly be issued by the National Society's Depository, Sanctuary, Westminster:—*How to Prepare Notes of Lessons*, by W. Taylor, Normal Master, St. John's College, Battersea. *Botany Reading Books*, Part I., by Rev. A. Johnson, St. Olave's Grammar School, Southwark. *Political Economy Reading Book*, by R. H. Inglis Palgrave. *Advanced History Reading Book*, being the supplemental volume of the English History Reading Books. *Geography Reading Books*, Part IV. *Geography Home Lesson Book*, No. 1, to accompany Part I. of the Geography Reading Books.

***

Messrs. Hildesheimer & Faulkner, art publishers, of 41, Jewin Street, E.C., announce that they will open early in August an Exhibition of Designs suitable for Christmas Cards, and offer the sum of £3,500 in prizes. The exhibition will be held in the Gallery of the Society of British Artists, and the judges are Messrs. W. P. Frith, R.A., J. E. Millais, R.A., and Marcus Stone, A.R.A.

***

Mr. G. Saintsbury, who is thoroughly competent for the work, has undertaken to edit a new edition of Scott's *Dryden*, for Mr. Patterson, of Edinburgh.

***

Prof. J. P. Postgate and Mr. C. A. Vince, Fellow of Christ's College, Cambridge, are engaged upon a much-needed work, a *Dictionary of Latin Etymology*, which will embody in an intelligible form the results of the most recent research. The book will be issued by Messrs. Macmillan and Co.

***

It is proposed to issue a series of small grammars of Oriental languages, under the editorship of Prof. E. H. Palmer. He will himself compile the Arabic, Persian, and Hindostani grammars.

***

A handsome memorial stone is being erected in Highgate Cemetery over the grave of the late Mrs. Cross, better known as 'George Eliot.' It is in the form of an obelisk, twelve feet in height, and has been designed by Messrs. Macdonald, Field, & Co., who are executing the work in Aberdeen granite. On the pedestal is the following inscription in gold letters:—

'Of those immortal dead who live again
In minds made better by their presence.'
Here lies the body of
'GEORGE ELIOT,'
MARY ANN CROSS.
Born 22nd November, 1819
Died 22nd December, 1880.

The French Académie des Sciences has passed a resolution for the purpose of founding a station for the study of zoology in the Eastern Pyrenees. The institution is to be in memory of Arago, the *savant*, who was a native of that part of the country.

* * *

Dr. E. A. Freeman, the historian, who has been travelling in Italy for several months, will shortly start on a tour through the United States. His health is much improved, but it is not yet sufficiently restored for him to resume his work.

* * *

M. Henri Taine's great work upon the *origines* of contemporary France consists of two parts. The first part was comprised in one volume, *L'ancien Régime.* Of the second part, two volumes have already appeared, *L'anarchie* and *La Conquête Jacobine.* In his preface to the last named, M. Taine promises a fourth and last volume, *Le Gouvernement révolutionnaire.*

* * *

Prof. Jowett's translation of Thucydides is about to be published by the Clarendon Press. It is contained in two handsome volumes, the first of which comprises the English text with a marginal analysis; while volume ii. has the notes and a long and elaborate essay on inscriptions of the age of Thucydides, and some shorter dissertations. Each volume is supplied with full and well-arranged indices, and the work is dedicated to Viscount Sherbrooke.

* * *

Mr. Edward Arber (Hon. Fellow of King's College, and Assistant Professor of English Literature in University College, London), whose excellent reprints of old texts are so well known, has been elected Professor of English Language and Literature at the Mason College, Birmingham.

* * *

Messrs. W. Swan Sonnenschein & Allen's announcements for early issue include a second edition, greatly revised, of Prank and Vine's *Elementary Text-Book of Botany;* a *Student's Handbook of German Literature*, by E. Nicholson; an addition to their series of Linear Blackboard (outline) Wall-maps, viz., the *Two Hemispheres*, and among others *A Comparison of Foreign Standards of Teaching*, with an introduction by A. Sonnenschein, and dedicated by permission to the Rt. Hon. A. J. Mundella, M.P., Vice-President of the Council. This last volume will contain also the standards just proposed by the Code Conference Committee.

* * *

Mr. Arthur Sidgwick is about to publish a new edition of the *Agamemnon* of Aeschylus, with notes suited to boys in the sixth form, and undergraduates at the universities.

* * *

The Council of the Society of Arts nave lately set up six new memorial tablets on houses in London in which great men have lived in times past. The six thus commemorated are Peter the Great, who stayed a short time in Buckingham Street, Strand; Sir R. Walpole, in Arlington Street; Sheridan, at 14, Saville Row; Barry the artist, in Castle Street, Oxford Street; Newton, in St. Martin's Street, Leicester Square; and Hogarth, at Archbishop Tennison's School.

* * *

Mr. William Poole, of 12A, Paternoster Row, will shortly issue a new volume of poems from the pen of Joseph S. Fletcher, which will be entitled *Songs after Sunset.*

* * *

As we go to press we are pleased to hear that upon the occasion of the Annual Pic-nic of the Westminster Wesleyan Training College, on June 25th, a banquet is to be given to Mr. Langler, President of the N.U.E.T. We hope in our next issue to give a full account of the proceedings.

—o—

Manuals on Education and Pedagogy.—The following list of manuals on education and pedagogy, from the catalogue of Mr. Thomas Laurie, of 31, Paternoster Row, is the most complete we ever remember having met with. We have not space to copy the prices, sizes, etc., of each work as given on the list: English Pedagogy: Education, the School and the Teacher in English Literature. American Pedagogy: Education, the School and the Teacher in American Literature. German Pedagogy: Education, the School and the Teacher in German Literature. Educational Biography—Memoirs of Teachers and Educators—Vol. I., The United States. German Educational Reformers, being Memoirs of Eminent Teachers, and Educators. National Education in the German States—Systems, Institutions, and Statistics of Public Instruction. Object Teaching and Method for Primary Schools. Studies and Conduct, being Letters, Essays, and Thoughts of Eminent Men. Pestalozzi and Pestalozzianism, being the Life, Educational Principles, and Methods. Technical Education—Systems, Institutions, and Statistics of Scientific Instruction applied to National Industries. Educational Aphorisms and Suggestions, Ancient and Modern. Military Systems and Education. Report on the Schools in the United States. Cyclopædia of Education by Kiddle and Schem. Quick's Essays on Educational Reformers. Abbott's Teacher. Stanley's Life of Arnold, Two Vols. Donaldson's Lectures on Education. Fearon's School Inspection. Leitch's Practical Educationists. Calderwood on Teaching. Gill's Systems of Education. Locke on Education. Rousseau's Emile. Paroz: Historie de Pédagogie. Reminiscences of Froebel, by Bülow. Currie's Principles and Practice of Education. Aschem's Scholemaster. Tate's Philosophy of Education. Latham on the Action of Examinations. Mill's Lecture at St. Andrew's University. Rollin's Method of Education, Four Vols. Stowe's Training System. Thompson's Day-Dreams of a Schoolmaster. Thring: Education and School. Wiese's Letters on English Education. Robinson's Manual of Method. Report of Committee of Council on Education in England. Johonnot's Principles and Practice of Teaching. Laurie's Primary Education. Fitch's Lectures on Education.

Matriculation Chemistry.

(*Continued from page* 85.)

BY E. W. V. VOLCKXSOM,
Lecturer on Chemistry at St Gregory's College, Downside, Bath.

24. Give the **atomic weights** of oxygen, chlorine, iodine, hydrogen, nitrogen, and carbon, according to the *hydrogen* and *oxygen* scales. *July*, 1858.

	Hydrogen Scale.	Oxygen Scale.
Oxygen,	16	100
Chlorine,	35·5	442·65
Iodine,	127	1579·5
Hydrogen,	1	12·48
Nitrogen,	14	177·04
Carbon,	12	75·4

25. Explain what is meant by the term **molecular weight.** One molecule of ammonia, consisting of one atom of nitrogen and three atoms of nitrogen, what is the molecular weight of ammonia? *June*, 1872.

By **molecular weight** is meant the sum of the atomic weights of the elements of a molecule.

The molecular weight of ammonia is $14+3=17$.

26. Give the molecular weights of **common salt, iodide of potassium, carbonic acid,** and **nitrate of silver.** (The following atomic weights may be adopted :—Chlorine, 35·5; sodium, 23; iodine, 127; potassium, 39; carbon, 12; oxygen, 16; nitrogen, 14; silver, 108.) *Jan.* 1865.

Common salt,	NaCl, has for molecular weight			58·5
Iodide of potassium,	KI,	"	"	166
Carbonic acid,	CO_2,	"	"	44
Nitrate of silver,	$AgNO_3$	"	"	170

27. Explain, with reference to examples, the meaning of the term **chemical equivalent.** *July*, 1844.

Chemical equivalent is a definite weight of an element capable of replacing a definite weight of another element. Since 35·5 parts by weight of chlorine combine with 1 part by weight of hydrogen to form hydric chloride, 35·5 parts by weight of chlorine are said to be equivalent to 1 part by weight of hydrogen. Also, since 2 parts by weight of hydrogen combine with 16 parts by weight of oxygen to form water, 8 parts by weight of oxygen are said to be equivalent to 1 part by weight of hydrogen. So also, as 35·5 parts by weight of chlorine are equivalent to 1 part by weight of hydrogen, they are by deduction equivalent to 8 parts by weight of oxygen.

28. Explain what is meant by **combining proportions, equivalents,*** or **atomic numbers.** July, 1849.

The examiner takes these three expressions as synonymous. They refer to the proportions, or the multiples of them, in which all the bodies combine among themselves. For example, the atomic weight of hydrogen is 1, that of oxygen 16, that of nitrogen 14, that of potassium 39: therefore, when these bodies form compounds among themselves, they will always do so in some simple multiples of 1, 16, 14, 39.

29. What is the composition of the following substances :—**Air, water, silica, marble, ammonia, marsh gas,** and **black lead** or plumbago?

Give the **names** of the substances represented by the following formulæ :—CO, NO, SO_2, N_2O_3, PH_3 and NH_4Cl. *Jan.* 1879.

Air, a mixture chiefly of oxygen, nitrogen, and carbonic acid.

Water (H_2O), a compound of oxygen and hydrogen.

Silica (SiO_2), a compound of silicon and oxygen.

Marble ($CaCO_3$), a compound of calcium, carbon, and oxygen.

Ammonia (NH_3), a compound of nitrogen and hydrogen.

Marsh gas (CH_4), a compound of carbon and hydrogen.

Black lead or plumbago is an allotropic modification of carbon.

The name of CO is carbonic oxide, or oxide of carbon.
" NO is nitric oxide, (N_2O_2).
" SO_2 is sulphuric dioxide, or sulphurous anhydride.
" N_2O_3 is nitric trioxide, or nitrous anhydride.
" PH_3 is hydric phosphide, or phosphuretted hydrogen.
" NH_4Cl is ammonic chloride.

30. Write the **names** of the following compounds :—CO, CO_2, N_2O, N_2O_3, N_2O_5, CH_4, C_2H_4, SO_2, SO_3, and H_2S. *Jan.* 1881.

The name of CO is carbonic oxide.
" CO_2 is carbonic dioxide, or carbonic acid.
" N_2O is nitrous oxide (laughing gas).
" N_2O_3 is nitric trioxide, or nitrous anhydride.
" N_2O_5 is nitric pentoxide, or nitric anhydride.
" CH_4 is light carburetted hydrogen (methyl hydride or marsh gas).
" C_2H_4 is heavy carburetted hydrogen (ethylene, or olefiant gas).
" SO_2 is sulphuric dioxide, or sulphurous anhydride.
" SO_3 is sulphuric trioxide, or sulphuric anhydride.
" H_2S is hydric sulphide, or sulphuretted hydrogen.

(*To be continued.*)

* The term *equivalent* was formerly used as synonymous with 'atomic weight'; but at present the term is scarcely used, and in its present meaning it signifies the atomic weight divided by the atomicity.

Pupil Teacher's Examination Questions.

MAY, 1881.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. If half a dozen herrings are sold for 3½d., what should be paid for 27, and what for 99 herrings?
2. What is the cost of 2 tons 2 cwt. 1 qr. 7 lbs. at £8 14s. 4d. per cwt.?
3. If £11 4s. 2¾d. be paid for 5 cwt. 3 qrs. 14 lbs., what is that per quarter?
4. Find the value of 104 Cheshire cheeses, each weighing 18¼ lbs. at 6¾d. per lb.

FEMALES.

1. Make out the following bill :—

				s.	d.	
6	ozs.	of	Berlin wool at	5	6	per lb.
4	doz.	,,	hooks ,,	3	0	per gross.
11½	yds.	,,	flannel ,,	1	2½	per yd.
1½	doz.	,,	collars ,,	0	7½	each.
16	pairs	,,	cuffs ,,	9	6	per doz. pairs.
15	pairs	,,	socks ,,	9	4	,, ,,
7	pairs	,,	gloves ,,	2	11½	per pair.
13¾	yds.	,,	ribbon ,,	1	11	per yd.
6¼	doz.	,,	collars ,,	0	8½	each.
127	yds.	,,	calico ,,	0	11¼	per yd.

2. Find the value of 10,445 at £1 17s. 8¼d. each.
3. 29 tons 6 cwt. 3 qrs. 19 lbs. at £11 13s. 4d. per ton.
4. 485 tons of coal were purchased at 15s. 9½d. per ton; in transit they were injured so much that they were worth only 10s. 6d. per ton.: find by Practice the loss incurred.

Grammar.

1. 'And in the nights of winter,
When the cold north winds blow,
And the long howling of the wolves
Is heard amidst the snow;
When round the lonely cottage
Roars loud the tempest's din,
And the good logs of Algidus
Roar louder yet within.'—MACAULAY.

(*a*) Point out and parse all the verbs, adjectives, and adverbs in the above.

2. Mention some nouns that are used only in the singular, and some that are used only in the plural, and account for this limitation in each instance.

Geography.

1. Describe a trip from London Bridge to Ramsgate and back again, keeping to the south side of the river in going, and crossing over to the north side in returning.
2. Describe the physical features of Northumberland, distinguishing carefully the different parts of the county. *If you can*, draw a map.
3. Name the *University towns* of Great Britain and Ireland, and say what you know about each.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Offspring*.

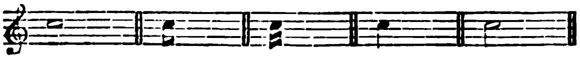
Write, in small hand, as a specimen of copy-setting, '*Was not your husband in Margaret's battle at St. Albans slain?*'

Music.

A quarter of an hour allowed for this paper.

1. Write, over each of the following notes, its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other) :—

2. Follow each of these notes by its corresponding rest :—



3. How many tones and semitones are found in a major scale, and what places therein do the latter occupy?

ANSWERS.—CANDIDATES.

Arithmetic.

MALES.

1. (a) 6 : 27 :: 3½d. : Ans.
3½d. × 27/6 = 1s. 3¾d. (1st Ans.)
(b) 6 : 99 :: 3½d. : Ans.
3½d. × 99/6 = 4s. 9¾d. (2nd Ans.)

2.

	£	s.	d.	
	8	14	4	
			6	
	52	6	0	
			7	
	366	2	0	= price of 42 cwt.
1 qr. = ¼ of 1 cwt.	2	3	7	= ,, 1 qr.
7 lbs. = ¼ of 1 qr.		10	10¾	= ,, 7 lbs.
	£368	16	5¾	= price of 42 cwt. 1 qr. 7 lbs.

3. 5 cwt. 3 qrs. 14 lbs. = 23½ qrs.
£11 4s. 2¾d. ÷ 23½ = 9s. 6½d.

£	s.	d.
11	4	2¾
		2

47)22 8 5½(9s. 6½d.
20
448
423
25
12
305
282
23
4
94
94

4. 104 × 18¼ = 1898 lbs. at 6¾d. per lb.
1898d.
6¾
4)5694
1423½
11388
12)12811½
2,0)106 7s. 7½d.
£53 7s. 7½d. Ans.

FEMALES.

				s.	d.		£	s.	d.
1.	6	oz. Berlin wool	at	5	6	per lb.	= 0	2	0¾
	4	doz. hooks	at	3	0	per gross	= 0	1	0
	11½	yds. flannel	at	1	2½	per yd.	= 0	13	10¾
	1½	doz. collars	at	0	7½	each	= 0	11	3
	16	pairs cuffs	at	9	6	per doz. pairs	= 0	12	8
	15	pairs socks	at	9	4	,, ,,	= 0	11	8
	7	pairs gloves	at	2	11½	per pair	= 1	0	8½
	13¾	yds. ribbon	at	1	11	per yd.	= 1	5	4¼
	6¼	doz. collars	at	0	8½	each	= 2	13	1½
	127	yds. calico	at	0	11¼	per yd.	= 5	19	0¾
						Total	= £13	10	10

2.

	£	s.	d.		
	10445	0	0	=	price of 10445 at £1.
10s. = ½ of £1	5222	10	0	=	,, ,, 10s.
5s. = ½ of 10s.	2611	5	0	=	,, ,, 5s.
2s. = ⅕ of 10s.	1044	10	0	=	,, ,, 2s.
6d. = ¼ of 2s.	261	2	6	=	,, ,, 6d.
2d. = ⅓ of 6d.	87	0	10	=	,, ,, 2d.
½d. = ¼ of 2d.	10	17	7½	=	,, ,, ½d.
£	10682	5	11½	=	price of 10445 at £1 17s. 8½d.

3.

	£	s.	d.		
	11	13	4 × 1		
			4		
	46	13	4		
			7		
	326	13	4		
	11	13	4		
	338	6	8	=	price of 29 tons.
5 cwts. = ¼ of 1 ton	2	18	4	=	,, 5 cwt.
1 cwt. = ⅕ of 5 cwt.		11	8	=	,, 1 cwt.
2 qrs. = ½ of 1 cwt.		5	10	=	,, 2 qrs.
1 qr. = ½ of 2 qrs.		2	11	=	,, 1 qr.
14 lbs. = ½ of 1 qr.		1	5½	=	,, 14 lbs.
4 lb. = ⅐ of 1 qr.			5	=	,, 4 lbs.
1 lb. = ¼ of 4 lbs.			1¼	=	,, 1 lb.
£	342	7	4¾	=	price of 29 tons 6 cwts. 3 qrs. 19 lbs.

4. Loss on 1 ton = (15s. 9½d. — 10s. 6d.) = 5s. 3½d.
485 at 5s. 3½d.

	£	s.	d.		
	485	0	0		
5s. = ¼ of £1	121	5	0	=	loss on 485 tons at 5s.
3d. = $\frac{1}{20}$ of 5s.	6	1	3	=	,, ,, 3d.
½d. = ⅙ of 3d.	1	0	2½	=	,, ,, ½d.
£	128	6	5½	=	loss on 485 tons at 5s. 3½d. per ton.

Grammar.

1. (*a*) *when*—relative adverb modifying the verb *blow*.
cold—adj. of quality qual. *winds*.
north—adj. of distinction pointing out *winds*.
blow—intrans. verb, strong conj. (*blow, blew, blown*), indic. mood, pres. indef. tense, 3rd pers. plur. agr. with subj. *winds*.
long—adj. qual. *howling*.
is heard—trans. verb, pass. voice, weak conj. indic. mood, pres. indef. tense, 3rd pers. sing. agr. with *howling*.
when—rel. adv. mod. *roars*.
lonely—adj. qual. *cottage*.
roars—intrans. verb, weak conj. indic. mood, pres. indef. tense, 3rd pers. sing. agr. with subj. *din*.
loud—adj. used as adverb modif. *roars*.
good—adj. qual. *logs*.
roar—intrans. verb, weak conj. indic. mood, pres. indef. tense 3rd pers. plur. agr. with subj. *logs*.
louder—adv. (in adj. form) comp. deg. modif. *roar*.
yet—adv. of degree modif. *louder*.
within—adv. of place modif. *roar*.

2. (1) Some nouns, from the nature of their signification, are used only in the singular, and these are names of materials, as *wine, water, silver*; abstract nouns (qualities), as *courage, whiteness, wit*. When these words do occur in the plural they more or less differ from the sense in which they are used in the singular.

(2) Other nouns, from having a kind of plural meaning about them, are found only in the plural, as *bellows, trousers, measles, nuptials*.

Geography.

1. On leaving London Bridge we may remark that the city is the largest and richest in the world. Continuing along the south bank of the Thames, we pass *Greenwich*, with its hospital and observatory, *Woolwich*, with its naval arsenal, *Gravesend*, with its numerous visitors, and come to *Sheerness*, where there is a strong fort, built after the attack of the Dutch (1667). Sailing eastward, we pass *Whitstable, Herne Bay, Margate*, a fashionable watering-place, round *N. Foreland*, and reach *Ramsgate*. The last two towns are situated in *Thanet*, which in the time of the Romans was a complete island, formed by two branches of the Stour. Returning, we pass, on the north side of the Thames, *Shoeburyness*, with its great guns, *Southend*, and *Tilbury*, famous for its fort in the days of Queen Elizabeth.

2. The western part of Northumberland is occupied by the great mountain ranges of the *Cheviot Hills* and the *Pennine chain*. The county is chiefly composed of the long sloping moors by which these hills descend to the sea. There are only two rivers of any importance, the *Tweed*, with its tributary the *Till*, in the north; and the *Tyne*, with its branch the *Derwent*, marks the southern boundary. A great coal-field lies along the banks of the Tyne. The eastern side of the county is washed by the *North Sea*, which supplies a ready transport for the coal.

3. The University towns in England, are—*Oxford*, on the Thames; *Cambridge*, on the Cam; *London; Durham*, noted for its Cathedral; and *Manchester*, famous for cotton manufactures.

In Scotland, *Edinburgh*, famous for its beauty; *Glasgow*, commercial capital of Scotland; *Aberdeen*, the 'granite city;' and *St. Andrew's*, famous for links and golfing.

In Ireland, *Dublin*, capital. Belfast, Cork, and Galway Colleges combine to form the Queen's University.

Music.

Five tones and two semitones, the latter being found between the third and fourth, and seventh and eighth notes.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What is the value in £ *s. d.* of ·4952 of 3 half-crowns multiplied by 12·3932?
2. Divide 7 miles 4 furlongs 28 poles 2 yards 0⅝ inch by 27⅞, and prove result by multiplication.
3. A bankrupt is able to pay ⅞ of ⅞ of his debts to his creditors. One of these, A, receives £1224, and another, B, receives £3978. What sum did the bankrupt owe to A, and what to B?
4. If 3 oz. of gold be worth £12·0297, what is the value of a nugget weighing 1·683 lbs.?

FEMALES.

1. A house worth £1125 is insured for three quarters of its value, at £2 5s. per £100; how much is the annual premium?
2. If I can walk 5 miles in one and a half hours, how long will it take me to walk 1320 yards?
3. If the fourpenny loaf weighs 14 oz. when wheat is 63 shillings a quarter, what should be the weight of the sixpenny loaf when wheat is 84 shillings a quarter?
4. If 100 men working 10 hours a day can dig a trench 16 ft. wide, 8 feet deep, and 40 yards long, how many men in the same time, working 8 hours a day, can dig a trench 17 ft. wide, 3 yards deep, and 30 yards long?

Grammar.

1. Between what different kinds of words does the preposition express the relation? Give examples.
2. Give the possessive cases of the pronouns *Thou, He, She, It, Who, They*.
3. Point out and parse the pronouns in the following passages:—

'He that hides a dark soul and foul thoughts,
Benighted walks beneath the mid-day sun;
Himself is his own dungeon.'—MILTON.

'And one spake on this manner, and another spake on that manner. Then arose Coifi and said: Tell us, O King, what this new law is.'

Geography.

Answer *two questions.*

1. Where are the counties of Caithness, Renfrew, and Peebles? Say what you know about each of them.
2. Draw a map to show the course of a traveller from Geneva to Marseilles, and then along the coast to Gibraltar.
3. Describe the physical features of Belgium, its rivers, chief towns, and industrial occupations.

History.

1. Give the dates of Egbert, Alfred, Canute, and Harold II.
2. Write out a list of our sovereigns from William II. to John, with dates.
3. What kings filled the English throne at the beginning of the eighteenth and at the beginning of the nineteenth centuries? Make a list of the sovereigns who reigned between them, and show their relationship.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Offspring.*

Write, in small hand, as a specimen of copy-setting, '*Was not your husband in Margaret's battle at St. Albans slain?*

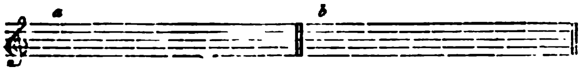
Composition.

Write from memory the substance of the passage read to you by the Inspector.

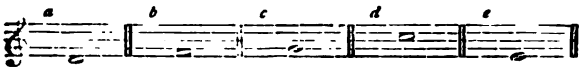
Music.

A quarter of an hour allowed for this paper.

1. Write in *a* the scale of F (*Fa*), and in *b* the scale of G (*Sol*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.



2. Place its third over (*a*), its fifth over (*b*), its fourth over (*c*), its second over (*d*), and its seventh over (*e*).



How many quavers are equal (in length) to one semibreve?

How many crotchets are equal (in length) to one dotted minim?

How many crotchets are equal (in length) to one dotted semibreve?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. This sum may be arranged thus:—

$$7·5\text{s.} \times ·4952 \times 12·3932 = £2\ 6\text{s.}\ 0·34\text{d.}$$

```
         ·4952
           7·5
        ------
         24760
        34664
      --------
       3·71400
      12·3932
      --------
          7428
        11142
       33426
      11142
       7428
     3714
    ----------
    46·0283448s.
            12
    ----------
     0·3401376 l.
```

2.

```
      mls. fur. po. yds. ft. in.    fur. po. yds. ft. in.
27 8/9 )7   4   28   2   0  0 8/9 (  2   8   0   2   1  Ans.
   9                        9
  ---  ----------------------------
  248  68   2   15  1½   0   8
        8
      ---
      546
      496
      ---
       50
       40
     ----
     2015
     1984
     ----
       31
       5½
     ----
      15½
     156½
     ----
      172
        3
     ----
      516
      496
     ----
       20
       12
     ----
      248
      248
```

PROOF.

mls.	fur.	po.	yds.	ft.	in.			
0	2	8	0	2	1 × 8/9			
					3			
0	6	24	2	0	3			
					9			
7	3	19	1¼	2	3	=	27	times.
	1	8	5	0	9 8/9	=	8/9	,,
7	4	28	2	0	0 8/9	=	27 8/9	,,

3. $\frac{3}{5}$ of $\frac{6}{7} = \frac{18}{35}$ = fraction paid to each.

$$\frac{35}{18} \text{ of } £1224 = \frac{£\overset{68}{\cancel{1224}} \times 35}{\cancel{18}} = £2380 \text{ sum owed to A.}$$

$$\frac{35}{18} \text{ of } £3978 = \frac{£\overset{221}{\cancel{3978}} \times 35}{\cancel{18}} = £7735 \quad ,, \quad ,, \quad \text{B.}$$

4. 3 oz. : $1·68\dot{3}$ lbs. :: $£12·\dot{0}29\dot{7}$

or 3 oz. : $\frac{101 \times 12}{60}$ oz. :: $£12\frac{3}{101}$

$$£\frac{\overset{243}{\cancel{1215}}}{\cancel{101}} \times \frac{\cancel{101}}{\cancel{5}} \times \frac{1}{3} = £81$$

FEMALES.

1. $\frac{3}{4}$ of £1125 = £843 15s.

£100 : £843 15s. :: 45s.

$$\frac{45\text{s.} \times 16875}{2000} = \frac{45 \times 135}{16} = \frac{6075}{16}\text{s.}$$

= £18 19s. 8¼d. Ans.

2. 8800 yds. : 1320 yds. :: 90 min.

$$\frac{90 \text{ min.} \times 1320}{8800} = \frac{9 \times 3}{2} \text{min.} = 13\tfrac{1}{2} \text{ min. Ans.}$$

3. 4d. : 6d. :: 14 ozs.

84s. : 63s.

$$\frac{14 \text{ oz.} \times 63 \times 6}{84 \times 4} = \frac{63}{4} = 15 \text{ oz. } 12 \text{ drs. Ans.}$$

4. 8 hrs. : 10 hrs. :: 100 men.
16 ft. : 17 ft.
8 ft. : 9 ft.
40 yds. : 30 yds.

$$\frac{100 \text{ men} \times 30 \times 9 \times 17 \times 10}{40 \times 8 \times 16 \times 8} = \frac{57375}{512} = 112\tfrac{31}{512} \text{ men.}$$

The $\frac{31}{512}$ = parts of the work that a man can do.

Grammar.

1. The preposition expresses the relation between a noun (or pronoun) and a noun, as *Queen of England;* between a noun and an adjective, as *ignorant of fate;* and between a noun and a verb, as *Wellington conquered at Waterloo.*

2.

NOMINATIVE.	POSSESSIVE.
Thou	thine (thy)
He	his
She	hers (her)
It	its
Who	whose
They	theirs (their).

3. *He*—3rd pers. pron., masculine, sing. nom., subj. of *walks.*
that—simple rel. pron. mas. agreeing with *he*, 3rd pers. sing. nom. subj. of *hides.*
himself—comp. pers. pron. (emphatic for *he himself*) 3rd pers. sing. nom. subj. of *is.*
his own—comp. pronominal adj. qual. *dungeon.*
one—indef. pron. 3rd per. sing. com. gen nom. subj. of *spake.*
another—indef. pron. 3rd pers. sing. com. gen. nom. subj. of *spake.*
us—1st pers. pron. còm. gen. plural, dative case (*to* understood).
what—interrogative (indirect) pron. sing. neu. nom. subj. of *is.*

Geography.

1. *Caithness.*—A county in the north of Scotland, bounded by the ocean on the north and south-east, and by Sutherland on the south-west, from which county it is separated by the Morven Hills and the Ord of Caithness. The bulk of the county is made up of moorlands surrounded by rugged sea-beaten rocks. The shire consists throughout its whole extent of Old Red Sandstone.

Renfrew.—This county lies on the south bank of the estuary of the Clyde, opposite to Dumbarton. It is separated from Ayrshire by a low ridge of rocks, and stretches eastward to the borders of Lanarkshire. It is the most thickly-peopled district in Scotland, owing to its geographical position. Its eastern portion lies within the coal-measures, and its western lies along the estuary of the Clyde, and includes the great ship-building yards which have made the river famous.

Peebles.—This county forms the upper basin of the Tweed. It is separated from Dumfries by Hart Fell, and by the Pentland Hills it is cut off from Midlothian. It touches Lanarkshire on the west, and Selkirk on the east. The shire consists of moorland and narrow mountain glens fitted only for sheep pasture.

3. BELGIUM.—*Physical Features.*—Belgium belongs to the great European plain. The ground in the eastern parts is hilly, and contains portions of the *Ardennes.* In the northern provinces the land is so low that it has to be protected from inundation by dykes, and on the west the sea is warded off by sand hills or downs, which are in some places covered with pine trees. The *Rivers* of Belgium are the *Meuse* and the *Scheldt*, which, with their tributaries, form a most abundant water communication. Canals also supply an important means of transit.

Chief Towns.—*Brussels*, a handsome city; several beautiful cathedrals; Waterloo 10 miles to the south. *Antwerp*, great emporium of Belgian commerce; beautiful Gothic cathedral, much admired. *Mechlin*, one of the chief seats of Belgian manufactures. *Ghent*, chief seat of cotton manufactures of Belgium, and a city of many historical associations. *Bruges*, noted for manufactures and its history. *Ostend* is the chief port of communication with England.

Industrial Pursuits.—The greater part of Belgium is not naturally fertile, but the industry of the people has rendered the soil highly productive. Spade-husbandry is extensively employed, and great attention is paid to the rotation of crops. Flax, hemp, and tobacco are grown, and cows in great numbers are kept in the western part of Flanders. A high value is also set on Flemish horses. The principal manufactures are lace, and linen. Liege is the centre of the iron manufacture, the principal iron-works being situated along the banks of the Meuse. Namur is noted for its fine cutlery.

History.

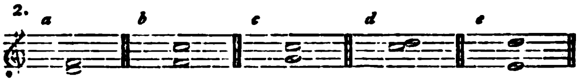
		A.D.
1.	Egbert began to reign (as King of England)	829
	Alfred ,, ,,	871
	Canute ,, ,,	1017
	Harold II. ,,	1066
2.	William II. began to reign	1087
	Henry I. ,, ,,	1100
	Stephen ,, ,,	1135
	Henry II. ,, ,,	1154
	Richard I. ,, ,,	1189
	John ,, ,,	1199

3. *William III.* filled the English throne at the beginning of the 18th century (1701), and *George III.* at the beginning of the 19th (1801). Between these two reigned
Anne, sister-in-law of William III.
George I., great-grandson of James I. through Elizabeth.
Anne was great-grand-daughter of James through Charles I.
George II., son of George I.
George III., grandson of George II. through Frederick, Prince of Wales.

Music.

1.

2.



3. Eight.
Three.
Six.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. At $3\frac{1}{2}$ per cent. per annum simple interest, how much will £6050 produce in $7\frac{1}{2}$ years?

2. In a school of 500 children, 24 per cent. are presented for examination in History, and of these 26·6 per cent. *fail.* How many *pass?*

3. A certain sum produces in 6 months, at 18 per cent. per annum simple interest, 19·4175 shillings. What is the sum?

4. If I buy 2 tons 3 cwt. 3 qrs. of sugar for £120, and pay £2 10s. for expenses, and then sell the sugar at four guineas per cwt, what do I clear per cent.?

FEMALES.

1. Divide $\dfrac{2 + 3}{4 + 5}$ by $\dfrac{4 + 3\frac{1}{2}}{5 + 5\frac{1}{2}}$

2. What number added to $\frac{31}{35} + \frac{19}{21}$ will produce $3\frac{227}{420}$?

3. Find the value of $\frac{3}{8}$ of a bushel — $\frac{5}{7}$ of a peck.

4. If $\frac{6}{7}$ of an estate be worth £1003 17s. 1d., what is the worth of $\frac{3}{5}$ of it?

Grammar.

1. 'Mahomet *made* the people *believe* that he would *call* an hill to him. The people assembled. Mahomet called the hill to him again and again; and when the hill stood still he was never *a whit abashed*, but said, "If the hill will not *come* to Mahomet, Mahomet will go to the hill."'—BACON.

(*a*) Analyse the subordinate sentences in the above, and state to what class each belongs.

(*b*) Point out the conjunctions in the above, and show what is the use of each in the context.

(*c*) Parse the words in italics.

2. Conjunctions have no power of governing a case. Is there any exception to this? If so, what is it? Give an example.

3. Mention some verbs that are used both as principal verbs and as auxiliary verbs. Give examples of both uses in the case of each verb.

Geography.

Answer *two questions.*

1. Describe the physical features of Belgium, its rivers, chief towns, and industrial occupations.

2. Give notes of a lesson on 'British Possessions in the Pacific.'

Draw a map or sketch maps to illustrate your lesson.

3. Name three or four native races who are subject to British authority in our foreign possessions; and describe the character of each.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. Who was Boadicea? Give some account of her revolt and overthrow.

2. When and how did Egbert of Wessex become king of England?

3. Where is Runnymede? Describe the event which makes it famous in our history.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Offspring*.

Write, in small hand, as a specimen of copy-setting, '*Was not your husband in Margaret's battle at St. Albans slain?*'

Composition.

Write full notes of a lesson on *The Census*.

Euclid.

[All generally understood abbreviations for *words* may be used, but no symbols of *operations*, such as −, +, ×, are admissible.]

1. Write out the *particular enunciation* (only) of the third proposition of Book I.

2. From a given point, to draw a straight line equal to a given straight line.

3. Two straight lines AB, CD, intersect at E; show that the bisectors of the angles AED, BEC are in the same straight line. [Apply I. 15.]

Music.

A quarter of an hour allowed for this paper.

1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms:—

2. Write in (*a*) two measures of common time, and in (*b*) two measures of triple time.

3. Write in (*a*) the signature of D (*Re*), in (*b*) that of B♭ (*Se*), in (*c*) that of A (*La*), and in (*d*) that of E♭ (*Me*).

ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1.

$$\begin{array}{rrr}
£ & s. & d. \\
6050 & 0 & 0 \\
 & & 3\tfrac{1}{2} \\ \hline
3025 & 0 & 0 \\
18150 & 0 & 0 \\ \hline
21175 & 0 & 0 \\
 & & 7\tfrac{1}{4} \\ \hline
5293 & 15 & 0 \\
148225 & 0 & 0 \\ \hline
1535{,}18 & 15 & 0 \\
20 & & \\ \hline
3{,}75 & & \\
12 & & \\ \hline
9.00 & &
\end{array}$$

£1535 3s. 9d. Ans.

2. 24 p. c. of 500 = $500 \times \frac{24}{100}$ = 120 No. presented.

If $26\frac{2}{3}$ p. c. fail, then $73\frac{1}{3}$ p. c. pass.

$73\frac{1}{3}$ p. c. of 120 = $120 \times \frac{220}{300}$ = 88. Ans.

3. £9 is derived in 6 mos. from £100

1s. " " " $£100 \times \frac{1}{180}$

19·4175s. " " $£100 \times \frac{19{\cdot}4175}{180}$

i.e. $£\frac{100 \times {\cdot}21575}{2}$

i.e. £10·7875

i.e. £10 15s. 9d. Ans.

4. 2 tons. 3 cwt. 3 qrs. cost £120 0s. + £2 10s.

1 cwt. " $£\frac{122{\cdot}5}{43{\cdot}75}$

" £2·8

∴ there is a gain per cwt. of £4·2 − £2·8 or £1·4

£2·8 gains £1·4

£100 " $£\frac{1{\cdot}4 \times 100}{2{\cdot}8}$

" " $£\frac{140}{28}$

i.e. 50 p. c.

FEMALES.

1. $\frac{5}{9} \div \frac{7\frac{1}{2}}{10\frac{1}{2}} = \frac{5 \times 21}{9 \times 15} = \frac{7}{9}$. Ans.

2. Required number $= 3\frac{227}{420} - (\frac{31}{35} + \frac{10}{21})$

$= 3\frac{227}{420} - \frac{372 + 200}{420}$

$= 3\frac{227}{420} - \frac{572}{420}$

$= 2\frac{5}{28}$. Ans.

3. $\frac{5}{9}$ bush. = $2\frac{2}{9}$ pks.

∴ $2\frac{2}{9}$ pks. $- \frac{5}{7} = \frac{140 - 45}{63} = 1\frac{32}{63}$. Ans.

4. $\frac{5}{7} : \frac{2}{5}$ :: £1003 17s. 1d.

£1003 17s. 1d. $\times \frac{7 \times 2}{5 \times 5}$

$$\begin{array}{rrr}
£ & s. & d. \\
1003 & 17 & 1 \\
 & & 7 \\ \hline
7026 & 19 & 7 \\
 & & 2 \\ \hline
5)14053 & 19 & 2 \\ \hline
5)2810 & 15 & 10 \\ \hline
562 & 3 & 2.
\end{array}$$

Ans.

Grammar.

1. (*a*)

Sentences.	Subject.	Predicate.	Object.	Extensions.
(*a*) That he would call an hill to him. (*Noun.*)	(that) he	would call	an hill	to him (*place*)
(*b*) When the hill stood still. (*Adverbial.*)	(when) the hill	stood		still (*manner*)
(c_1) Mahomet will go to the hill,	Mahomet	will go		to the hill (*place*)
(c_2) If the hill will not come to Mahomet. (*Noun.*)	(if) the hill	will not come		to Mahomet

Note.—*c_1 and c_2 form one noun sentence; c_2 is adverbial to c_1.*

CONJUNCTIONS.

(*b*) *That*—connecting a subordinate noun clause with the principal.

(1) *and*—connecting two adverbs.

(2) *and*—connecting two principal sentences.
when—connecting subordinate adverbial clause with a principal.
but—contrasting two principal sentences.
if—connecting a subordinate adverbial clause of condition with a principal.

(*c*) *made*—trans. verb, strong conj. (*make, made, made*), indic. mood, past indef. tense, 3d pers. sing. agr. with *Mahomet.*
(*to*) *believe*—trans. verb, weak conj., infinitive mood, pres. indef. tense (*to* omitted after *made*).
call—trans. verb, weak conj., infin. mood, pres. indef. tense (*to* omitted after *would*).
(*by*) *a whit*— = adverb of degree modif. *abashed.*
abashed—verbal adj. qual. *he.*
come—intrans. verb, strong conj. (*come, came, come*), infin. mood, pres. indef. tense gov. by *will.*

2. *Than* is an exception to the non-governing power of conjunctions, though by some it is considered a preposition, as, 'His father is dead, *than whom* I never knew a better man.'

3. *Principal.*	*Auxiliary.*
Thou *doest* well.	Thou *dost* read.
It is not of him that *willeth.*	We *will* be avenged.
You *should* not do that.	If you *should* see John, tell him all.
You *may* go.	It is possible that I *may* be mistaken.
Have you a book?	You *have* read the book.
He *was* at home.	He *was* seen at home.

Geography.

1. *See same question answered under 'First Year.'*

2. NOTES ON 'BRITISH POSSESSIONS IN THE PACIFIC.'

Australia.—Largest island on the globe—sometimes called a continent—its seasons the opposite of ours—coast line small in proportion to the extent of the island—has very few great rivers, the *Murray* the chief, its largest tributary the *Darling*—many small rivers never reach the sea, but are lost in the soil—highlands all near the coast. Chief mountains in south-east—*Australian Alps—Blue Mountains.—Dividing Range*—highest peak, Mt. Kosciusko. Interior is treeless—soil, with exception of a barren region in the middle, fertile—*Great Barrier Reef* forms a natural breakwater. *Divisions—West Australia—South Australia—New South Wales—Victoria—Queensland. Chief Towns—Melbourne—Sandhurst—Castlemaine—Geelong—Sydney—Maitland—Bathurst—Goulbourn—Brisbane—Adelaide—Perth. Climate*—Monsoons blow in the north—westerly winds prevail in the south—long droughts—hot winds. *Productions*—Gold, copper, wool, tallow, gum-trees, acacias, heaths—food plants of Europe grown—native animals nearly all pouched—lyre-bird, emu, and black swan peculiar.

Tasmania.—Heart-shaped—named from Tasman—surface varied—coast irregular—size of Scotland—mountainous in north and west—*Mt. Humboldt*—lakes in middle—people employed in rearing cattle and sheep. Capital, *Hobart Town*—second town, *Launceston. Products*—Iron, copper, timber, wool.

New Zealand.—Antipodes of England—consists of two large islands, *North Island* and *South Island*, and a number of small islands, of which Stewart I. is the chief—area larger than Great Britain—climate healthy. Mountains—*Southern Alps—Mt. Cook.* Many lakes and rivers. *Products*—Coal, iron, gold, timber, etc. *Chief Towns—Auckland—Wellington—Blenheim—Christchurch—Dunedin—Invercargill.*

Fiji Isles.—Finest group in South Pacific—extremely fertile—well wooded. The two large islands are *Viti* and *Vanna*—capital, *Levuka*, with an excellent harbour. *Products*—Bread-fruits, bananas, sugar, tobacco, cotton.

Vancouver Island.—Diversified by hill, lake, and valley—soil rich—produces luxuriant vegetation—coal has been found of good quality. Capital, *Victoria*—belongs to British Columbia.

Hong Kong.—At mouth of Canton River—*Victoria* chief town.

Labuan.—On north-west coast of Borneo—great quantities of coal—chief settlement, *Victoria Harbour.*

3. In Cape Colony the *Caffres* and *Hottentots* are subject to British authority. The former are bold, warlike, and intelligent, engaged in agriculture and pastoral pursuits; the latter are a lazy, degraded, and filthy race. In New Zealand the *Maoris* are tall, well-built, and intelligent, with glossy hair and a copper complexion. The *Aborigines* of Australia are of the lowest type, live in holes in the earth, wear little clothing, and live on fish and roots.

History.

1. Boadicea was queen of the Iceni, a tribe of South Britain. While Suetonius Paulinus was on an expedition to Mona (Anglesey) she revolted, and burned London, Camulodunum and other Roman towns, besides defeating the Romans. Suetonius, however, on his return utterly routed her assembled forces, and she, to escape disgrace, poisoned herself.

2. Egbert, the wisest and most powerful of the kings of Wessex, in 823 defeated the Mercians, who had invaded his dominions, and wrested from them the tributary kingdoms of Kent and Sussex. The East Angles revolted from Mercia, and placed themselves under Egbert, who soon afterwards received the submission of Northumbria. Thus England was virtually united in 827 under Egbert, the eighth Bretwalda.

3. Runnymede is a meadow on the Thames, not far from Windsor. Here, in the summer of 1215, the barons met King John, and after some discussion got him to sign Magna Charta, which bound the kings of England to grant to their people many of the chief privileges which they still enjoy.

Composition.

NOTES OF A LESSON ON *The Census.*

Definition.—An enumeration of the people and a collecting of information regarding their ages, occupations, place of birth, nationality,—might be compared to the information given by a boy on coming to school for the first time—his name entered in class and general registers, date of birth, etc.

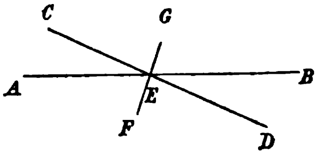
How the Census is taken.—Some days before, enumerators are appointed by the registrar. These distribute schedules to every householder in their several districts; notes taken at same time of street, house, occupier, and number of windowed rooms. Then all who sleep in the house on first Sunday night of April written down on schedules, which are called for during the Monday. Enumerators examine the schedules as they lift them, make any necessary corrections, and after entering them all into a large book, carry the results to the registrar, who transmits them to the proper authorities, and these again to the Home Secretary's office in London.

Use of the Census.—Gives interesting information about the progress of a country—its increase or diminution of population—the number of men able, if necessary, to defend their country—as to the numbers of members of Parliament for certain counties, cities, or towns—the number of children of school age—the wealth of a nation.

Euclid.

1. The *particular enunciation* is, 'Let AB and C be two given straight lines of which C is the less, it is required to cut off from AB a part equal to C.'

2. Prop. 2, Bk. I.



3. Let the angle AED be bisected by FE, and CEB by GE; then GE shall be in the same straight line with FE. Because the angle CEB is equal to the angle AED, the halves of these are equal (I. 15), and AEC is equal to BED (I. 15). Therefore the three angles GEC, CEA, AEF are together equal to the three GEB, BED, DEF. But (by the corollary to I. 15) these six angles are together equal to four right angles, and therefore the three angles on either side of FEG are together equal to two right angles, and therefore FEG is a straight line.

Music.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May,* **1878; and Pupil Teachers at end of Fourth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What per-centage of 1·5 tons is (*a*) 1 cwt.? (*b*) 1 quarter? (*c*) 1 lb.? Give answers in decimals.

2. The cost of maintaining a certain school is £110 a year. The Government grant amounts to £29 10s. 0d., and the school fees to $\frac{17}{59}$ of that sum. What per-centage of the expenditure is met by (*a*) the grant? (*b*) the fees? Give answers in decimals.

3. If railway stock, bought at 28 per cent. *premium*, pays $7\frac{1}{2}$ per cent. on the investment, what per cent. would it pay if bought at 10 per cent. *discount?*

4. If I invest in 4 per cent. stock standing at $77\frac{1}{2}$, at what rate per cent. shall I receive interest for my money?

FEMALES.

1. Divide ·0625 by 1·75; and express $\frac{7}{12\frac{4}{5}}$ as a decimal.

2. A, after doing $\frac{3}{8}$ths of a piece of work in 30 days, calls to his assistance B, and together they finish it in 6 days; in what time would B do it alone?

3. Reduce 1 fur. 30 po. to the decimal of a league; and 7 guineas to the decimal of £5 10s. 11d.

4. Required the expense of painting the outside of a cubical box whose edge is 3·5 ft., at 1·3s. per sq. yd.

Grammar.

1. . . . . 'The voice of Enid rang
Clear through the open casement of the Hall,
Singing; and, as the sweet voice of a bird,
Heard by the lander in a lonely isle,
Moves him to think what kind of bird it is
That sings so delicately clear, and make
Conjecture of the plumage and the form;
So the sweet voice of Enid moved him.'—TENNYSON.

(*a*) Point out and analyze the noun sentence in the above passage.
(*b*) Parse the participles, and infinitive moods, in the above.
(*c*) Explain how the word 'what' is used in the fifth line, and give other uses of the same word.
(*d*) Give the meaning of the above passage in plain, simple words of your own.

2. Give examples of words compounded with the Latin preposition *in* (meaning in, into). Mention some words in which the affix *in* has quite a different meaning, and state what that meaning is.

Geography.

1. Give full notes of a lesson on '*Arabia and the Arabs.*'
Draw a map in illustration.
N.B.—No Introduction.

2. Name, in order, and describe the chief seaports of Africa.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. When, where, and with what result was the battle of Flodden Field fought? What occasioned war between the two countries at that time?

2. Give the name and date of the last King of England who died a violent death, and describe his end.

3. Mention some of the most striking proofs of progress and social improvement since the beginning of this century.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Offspring.*

Write, in small hand, as a specimen of copy-setting, '*Was not your husband in Margaret's battle at St. Albans slain?*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation*, such as −, +, ×, are not admissible.]

1. From a given isosceles triangle cut off a trapezium which shall have the same base as the triangle and its remaining three sides equal to each other.
[Bisect the angles at the base, etc.]

2. State the *particular enunciation* (only) of the twenty-seventh proposition of Book I.

3. If a side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles; and the three interior angles of every triangle are together equal to two right angles.

Algebra.

1. Find the value of $c\left(\frac{a(a+b)-(a^2-b^2)}{a^2-b^2-a(a-b)+b^2}\right)$ when $a=2$, $b=4$, $c=6$.

2. Multiply x^2+x-2 by x^2+x-6; and divide the product by x^2+5x+6.

3. Solve the equations:—

$$(1)\ \frac{ax}{b}+\frac{cx}{d}+\frac{ex}{f}-g=h.$$

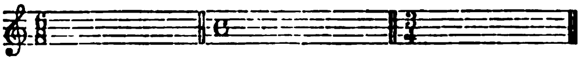
$$(2)\ \frac{2x+1}{29}-\frac{402-3x}{12}=9-\frac{471-6x}{2}.$$

Music.

A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of E (*Mi*). Mark the places of semitones:—

2. Write measure, of rests only, in each of the kinds of time indicated by the following signatures:—



3. Write over each of the following the name of the major scale, and under each that of the minor scale, of which it is the signature:—

ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. 1 cwt. is $\frac{1}{30}$ of 1·5 tons (30 cwt.) or $\frac{100}{30}$ p. c., *i.e.* $3\cdot\dot{3}$ Ans.
1 qr. „ $\frac{1}{120}$ „ (120 qrs) „ $\frac{100}{120}$ „ *i.e.* $\cdot 8\dot{3}$ Ans.
1 lb. „ $\frac{1}{3360}$ „ (3360 lbs.) „ $\frac{100}{3360}$ „ *i.e.* ·029761904 Ans.

2. $\frac{17}{59}$ of £29 10s. $= \frac{590\text{s.} \times 17}{59} =$ £8 10s. school fees;

∴ grant pays £29 10s. in £110, or $\frac{£29\ 10\text{s.} \times 100}{110}$ p. c.

$\frac{£29{\cdot}5 \times 10}{11}$ p. c. $= 26\cdot\dot{8}\dot{1}$ Ans.

And fees pay £8 10s. in £110, or $\frac{8{\cdot}5 \times 100}{110}$ p.c. $= 7\cdot\dot{7}\dot{2}$. Ans.

3. For 128 to bring $7\frac{1}{2}$ p. c, it must have been invested in the $\frac{128 \times 7\frac{1}{2}}{100}$ or the 9·6 p. c.

At a discount of 10 the percentage $= \frac{9{\cdot}6 \times 100}{90} = 10\frac{2}{3}$ p. c. Ans.

Briefly stated, the sum may be worked thus:—

$90 : 128 :: 7\frac{1}{2} : 10\frac{2}{3}$.

4. An investment of £$77\frac{1}{2}$ brings an income of £4.
„ £1 „ £$\frac{4}{77\frac{1}{2}}$.
100 „ £$4 \times \frac{100}{77\frac{1}{2}}$,
i.e. $5\frac{5}{31}$ p. c.

FEMALES.

1. (*a*) 1·75)·0625(·0357142̇8̇

```
 525
 ----
 1000
  875
 ----
 1250
 1225
 ----
  250
  175
 ----
  750
  700
 ----
  500
  350
 ----
 1500
 1400
 ----
```

(*b*) $\frac{7}{12\frac{4}{5}} = \frac{35}{64} = \frac{4·375}{8} = ·546875$. Ans.

2. $\frac{3}{5}$ths in 30 days $= \frac{1}{50}$ every day,
$= \frac{6}{50}$ in 6 days;

$\therefore$ A does $\frac{30+6}{50} = \frac{18}{25}$ of the whole;

$\therefore$ B „ $\frac{7}{25}$ in 6 days,

or B „ the whole in $\frac{25}{7} \times 6$ days, or $21\frac{3}{7}$ days. Ans.

3. (*a*) $\frac{\text{1 fur. 30 po.}}{\text{3 mls.}} = \frac{\text{70 po.}}{\text{960 po.}} = ·07291\dot{6}$. Ans.

(*b*) $\frac{\text{7 gui.}}{\text{£5 10s. 11d.}} = \frac{\text{147s.}}{\text{110s. 11d.}} = \frac{1764}{1331} = 1·32531$ . . .

4. 3·5 ft. × 3·5 ft. × 6 = 73·5 sq. ft. = $8\frac{1}{6}$ sq. yds.
$8\frac{1}{6}$ yds. at 1·3̇s. each = $\frac{4}{3}$s. × $\frac{49}{6}$ = 10s. $10\frac{2}{3}$d. Ans.

Grammar.

1. (*a*) '*What kind of bird it is*' is the noun sentence.
It—subject.
is what kind of bird—predicate.

(*b*) *singing*—incomplete part. of a verb of strong conj. (*sing, sang, sung*), qual. *voice.*
heard—complete part. of a verb of weak conj. qual. *voice.*
to think—trans. verb, infin. mood, strong conj. (*think, thought, thought*), pres. indef. tense, gov. by *moves.*
make—trans. verb, infin. mood, strong. conj. (*make, made, made*), pres. indef. tense gov. by *moves.*

(*c*) *What* is an adjective qual. *kind.* Besides being an adjective, *what* is also a compound pronoun; as, 'Tell *what* he said,' and an interrogative, as, '*What* did you say?'

(*d*) The window of the Hall was open, and as Enid sang the notes were heard as clear as the song of a bird which has caught the ear of the solitary dweller on an island, and has so much interested him by the purity of its tone that he tries in imagination to make out the species, and even guesses at its shape and the colour of its feathers. He is just as much stirred by Enid's song as that recluse by the notes of the bird.

2. The following words are compounded with *in* (meaning in, into): *in*stil, *il*lusion, *im*becile, *ir*radicate, *en*grave.

The prefix *in* has quite a different meaning in the following:—*in*action, *ig*noble, *il*legal, *im*maculate, *ir*rational; in these words the prefix means *not.*

Geography.

ARABIA AND THE ARABS.

1. *Boundaries.*—N., Syria and the Euphrates; E., Persian Gulf; S., Indian Ocean; W., Red Sea and Isthmus of Suez. *Length.*—1,600 miles. *Breadth.*—1,000 miles. *Population.*—10,000,000.

General Aspect.—Surface, an immense plateau, skirted along W. and S. by mountain chains—Horeb and Sinai, in peninsula of Sinai, greatest heights—coasts low, and fertile where well-watered—interior, immense shifting sands—no rivers, except in the rainy season.

Climate.—One of the driest in the world—heat of plains excessive—temperate in highlands—simoom blows from interior to coasts.

Productions.—Vegetables, date, palm, coffee, cotton, spices, vines, fig, etc. Animals, horse and camel most important, as they form the chief wealth of the Arabs. All kinds of industry unimportant, but large quantities of merchandise brought by sea and caravans.

Chief Towns.—*Mecca*—'Holy City,' birth-place of Mahomet; *Medina*—where Mahomet is buried; *Mocha*—famed for its fine coffee; *Aden*—strongly fortified (British); *Muscat*—great emporium of commerce.

Arabs.—People of two classes—those settled in towns, and Bedouins, or children of the desert—supposed to be descended from Ishmael—wander with flocks and herds—dwell in tents, and live partly by plunder—government is vested in the Bedouin chief, styled *Sheikh* or *Emir.*

CHIEF SEA-PORTS OF AFRICA.

2. *Alexandria*—founded by Alexander the Great; important station on the overland route. *Tunis*—next to Cairo in population, and to Alexandria for commerce. *Mogadore*—chief seaport of Morocco in a barren district. *Lagos* has superseded *Badagry* as a port. *Loando* carries on trade with Lisbon. *Cape Town*—stands on the south side of Table Bay, and is a well-built town. *Port Elizabeth* is the principal place for shipping on the eastern part of Cape Colony. *D'Urban* is the chief port of Natal. *Mozambique*—exports slaves, ivory, and gold-dust. *Mogadoxa* is the chief port on the east coast. *Massowah*—the chief port of Abyssinia—stands on an island. *Suez* is a station on the overland route.

History.

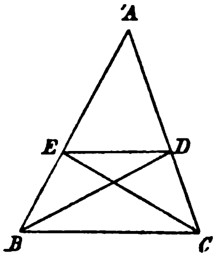
1. The battle of Flodden was fought on Flodden Hill, a height in the Cheviot Range, eight miles north-west of Wooler, in Northumberland. The Scots in this battle suffered a most disastrous defeat from the Earl of Surrey, the King and most of his nobility being slain (1513).

The causes of the war at that time were—(1) The piratical expeditions of the Scottish sailors; (2) Complaints were made by the Scottish King that certain money and jewels which James's Queen had inherited from her father had been withheld by Henry VIII.; (3) James was incited by the Queen of France to be her champion, and to break a lance with her enemy the King of England.

2. The last English King who died a violent death was Charles I., who was executed 30th January, 1649. He was conducted to Whitehall by Major Harrison. Next day the Court of Justice met in Westminster Hall, and on the 27th January passed sentence of death on Charles. Two days intervened between the sentence and the execution. These were spent by Charles in devotion and in parting with his children. Bishop Juxon, who accompanied him to the scaffold, said to him, 'There is, Sir, but one stage more, which, though turbulent and troublesome, is yet a very short one. It will carry you to heaven, and there you shall find a crown of glory.' 'I go,' said Charles, 'from a corruptible to an incorruptible crown, where no disturbance can have place.' At one blow his head was severed from his body. The executioner held up the head and said, 'This is the head of a traitor.'

3. The application of steam to the purposes of locomotion has wrought a marvellous change upon the life of the civilized world since this century began. Steamboats were invented, and then George Stephenson achieved the construction of a locomotive engine, capable of drawing carriages on a line of rails. The efforts of Rowland Hill ended in the establishment of a general *penny postage.* But this was little beside the achievement of Cooke and Wheatstone, who constructed the electric telegraph. Submarine cables were eventually laid between Europe and America. The lighting of houses and towns with gas, free trade, Reform Bill, and Education Act are all evidences of social improvements.

Euclid.



1. Bisect the angles at the base of the isosceles triangle by the straight lines BD, CE, and produce them till they meet the sides AC, AB in D and E. Then BEDC shall be the trapezium required. Because in the triangles EBC, DBC there are two angles, EBC, ECB, respectively equal to DCB, DBC, and one side, BC, common. Then (by I. 26) the triangles are equal, and they are on the same base, BC. They are therefore between the same parallels. Join ED; ED is parallel to BC, and the angle DEC is equal to the alternate angle ECB; but ECB is equal to DCE. Therefore DE = DC, and in the same manner DE = EB; and therefore the three sides CD, DE, EB of the trapezium EDCB are equal—Q. E. F.

2. The particular enunciation of I. 27 is, 'Let the straight line EF, which falls upon the two straight lines AB, CD, make the alternate angles AEF, EFD equal to one another; then AB shall be parallel to CD.'

3. Prop. 32, Bk. I.

Algebra.

1. Substituting figures for letters, the expression is

$$6\left(\frac{2(2+4)-(2^2-4^2)}{2^2-4^2-2(2-4)+4^2}\right)=$$
$$6\left(\frac{(4+8-4+16)}{4-16-4+8+16}\right)=$$
$$6\times\tfrac{24}{8}=18. \quad \text{Ans.}$$

2.
$$\begin{array}{l}
x^2+x-2 \\
x^2+x-6 \\
\hline
x^4+x^3-2x^2 \\
\quad\; x^3+x^2-2x \\
\qquad -6x^2-6x+12
\end{array}$$

$$x^2+5x+6)\,x^4+2x^3-7x^2-8x+12\,(x^2-3x+2$$
$$\begin{array}{l}
x^4+5x^3+6x^2 \\
\hline
-3x^3-13x^2-8x \\
-3x^3-15x^2-18x \\
\hline
\qquad 2x^2+10x+12 \\
\qquad 2x^2+10x+12
\end{array}$$

3. (1) L. C. M. of denominators $=bdf$;

$$\therefore\ adfx+bcfx+bdex-bdfg=bdfh,$$
$$adfx+bcfx+bdex=bdf(g+h),$$
$$x=\frac{bdf(g+h)}{adf+bcf+bde}.$$

(2) L. C. M. of denominators $=29\times12$;

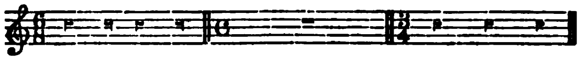
$$\therefore\ 24x+12-11658+87x=3132-81954+1044x,$$
$$24x+87x-1044x=3132+11658-12-81954.$$

Collecting and changing signs $933x=67176$,
$$x=72. \quad \text{Ans.}$$

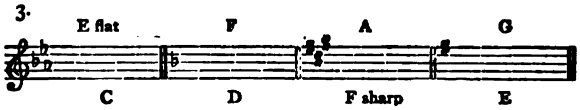
Music.

1.

2.



3.



FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May,* 1878; **and Pupil Teachers at end of Fifth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. A capitalist invested £6940 in 3 per cent. Consols standing at 86⅝, and sold out when they had risen 3½ per cent. What was his gain, the brokerage on each transaction being ⅛ per cent.?

2. A sum of money amounts in 10 years, at 3½ per cent., simple interest, to £506 15s. 1½d. To what sum will it amount in 15 years more?

3. The ready-money price of an article at a tradesman's who allows mercantile discount in the ordinary way for ready money is £8 11s., and the credit price is £9. What ought the credit price to be in order that, while charging the same ready-money price he may allow *twice* the rate of discount?

4. What is the annual income derivable from a sum of £7850 invested in stock standing at 98⅛, and yielding the same rate of interest at which £7864 12s. 6d. will amount in 5 years to £9175 7s. 11d.?

5. A market woman sold out of a basketful of eggs, to A, one-third, less by 5, of what she had; to B, one-fifth of what she then had, less by 12; and to C, three-fourths of what she then had, less by 20. She had still 80 eggs left: how many had she at first?

FEMALES.

1. At what rate per cent. will £540 amount to £734 8s. in 9 years at simple interest?

2. In a class of 25 children, 19 have attended during the week. Days attended by children, 5 for 5 days; 6 for 4½; 3 for 4; 2 for 3½; 1 for 3; 1 for 2; 1 for ½ day. Find the average number of days attended by each child.

3. In standard gold, 11 parts out of 12 are pure gold. How much per cent. is dross?

4. Divide 40 guineas among A, B, and C, so that their portions may be as 7, 11, and 14 respectively.

Grammar.

'*What* makes this world to be so variáble
But lust[1] *that* folk have in dissensión?
For nowadays a man is held unable[2]
But *if*[3] *he can*, by some collusión,[4]
Do his neighbour wrong and oppressión.
What causeth this but wilful wretchedness,
That all is lost *for lack* of steadfastness?'
CHAUCER.—*Ballad sent to King Richard.*

[1] pleasure [2] fit for nothing [3] unless [4] fraud or deceit.

(*a*) What King Richard is meant? and how long ago did he live?
(*b*) Write out the sense of the first five lines in modern English.
(*c*) Point out any words in the above which seem to you to be derived from the French or Latin languages.
(*d*) Parse the words in italics.
(*e*) Analyze the 3rd, 4th, and 5th lines.

Geography.

1. Describe a journey by land from New York to San Francisco.

Draw a map of the United States in illustration of your lesson.

2. Where and what are Chili, Chimborazo, Juan Fernandez, Magellan, Monte Video, Quito, Rio de Janeiro, Tierra del Fuego, Valparaiso? Say what you know of each.

SECOND PAPER.

One hour allowed for Females, two hours and a half for Males.

History.

1. Would you say that the various invasions of this island from the south and the north of Europe were beneficial or injurious to the inhabitants? Give your reasons.

2. Give the names and dates of the sovereigns of England who have died by a violent death, and sketch the character of one of them.

3. When were the Acts of Supremacy and Uniformity passed? What were their provisions? and what parties refused to be bound by them?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Offspring*.

Write, in small hand, as a specimen of copy-setting, '*Was not your husband in Margaret's battle at St. Albans slain?*'

Composition.

Write a short essay on 'The Census.'

Euclid.

(The only abbreviations admitted for '*the square on AB*' is '*sq. on AB*,' and for '*the rectangle contained by AB and CD*,' '*rect. AB, CD*.')

1. If ABFG, ACKH be the squares on the sides AB, AC of a triangle right-angle at A, and if M, N, be the feet of the

perpendiculars dropped from F and K respectively upon BC produced, prove that BM is equal to CN.

(Draw AR perpendicular to BC; prove the triangle CNK equal to the triangle ARC, and the triangle BMF equal to the triangle ARB, &c.)

2. If a straight line be divided into any two parts, the squares on the whole line, and on one of the parts, are equal to twice the rectangle contained by the whole and that part, together with the square on the other part.

Algebra.

1. Find the G. C. M. of $24x^4-22x^2+5$, and $48x^4+16x^2-15$, and reduce $\dfrac{24x^4-22x^2+5}{48x^4+16x^2-15}$ to lowest terms.

2. Solve the equations :—

(1) $$\left.\begin{aligned} 2x-\frac{y-3}{5}&=4 \\ 3y+\frac{x-2}{3}&=9 \end{aligned}\right\}$$

(2) $$\frac{x}{7}+\frac{21}{x+5}=6\tfrac{2}{7}.$$

3. A man walked 8 miles 1320 yards in a certain number of hours, less by one than the number of miles he walked in an hour; how long did he walk?

Can you explain the meaning of the negative root of the equation obtained in working this problem?

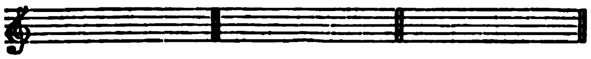
Mensuration.

ABCD is a trapezium, of which the diagonal AC is 325 yards, and the sides AB, BC, CD, DA are 123, 208, 116, 231 yards respectively; find the area in acres, roods, and poles.

Music.

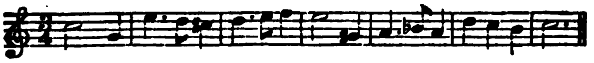
A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of D (*Re*) minor in every form with which you are acquainted. Mark the places of the semitones, and augmented intervals.



2. Write, under each of the following pairs of notes, the name and quality (major, perfect, diminished, or other) of the interval it forms :—

3. Transpose the following into B♭ (*Se*) :—



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. Paid for stock $86\tfrac{5}{8}+\tfrac{1}{8}$ or $86\tfrac{3}{4}$ p. c.
Sold his stock $90\tfrac{1}{8}-\tfrac{1}{8}$ or 90 „

Gained $3\tfrac{1}{4}$ on $86\tfrac{3}{4}$ of capital.

$86\tfrac{3}{4}:6940::3\tfrac{1}{4}$:profit.

$£6940\times\frac{13}{347}=20\times13=£260$. Ans.

2. Amount of £100 for 10 years at $3\tfrac{1}{2}$ p. c. = £135.

£ : £ s. d. :: £ : £ s. d.
135 : 506 15 $1\tfrac{1}{2}$ :: 100 : 375 7 6
Amount. Principal. Interest.

∴ £506 15s. $1\tfrac{1}{2}$d. − £375 7s. 6d. = £131 7s. $7\tfrac{1}{2}$d.

$\cancel{10}$ yrs : $\cancel{25}$ yrs. :: £131 7s. $7\tfrac{1}{2}$d.
2 5 5

2)656 18 $1\tfrac{1}{2}$

Amount = £506 15s. $1\tfrac{1}{2}$d. + 328 9 $0\tfrac{3}{4}$ = £835 4s. $2\tfrac{1}{4}$d.

3. 9s. discount off £9 = $\tfrac{1}{20}$ or 5 p. c.;

∴ in order that 10 p. c. may be allowed he must charge $\tfrac{110}{100}$ of £8 11s., or

£9 8s. $1\tfrac{2}{11}$d. Ans.

4. (*a*) $98\tfrac{1}{8}$:7850::100:£8000 stock.

$$£100\times\frac{7850\times8}{785}=£8000.$$

(*b*)

£	s.	d.
9175	7	11
7864	12	6
5)1310	15	5
262	3	1

Interest per annum.

$7864\tfrac{5}{8}$:8000::£262 3s. 1d.:
8 8 20

62917 6400 5243
12

62917d.

$$\frac{\cancel{62917}\text{d.}\times64000}{\cancel{62917}}=64000\text{d.}=£266\ 13\text{s.}\ 4\text{d.}$$

5. $(80-20)4$ = no. before C got his = 240
$(240-12)\tfrac{5}{4}$ = „ B „ = 285
$(285-5)\tfrac{3}{2}$ = „ A „ = 420. Ans.

FEMALES.

1. £734 8s. − £540 = £194 8s. = interest.

£ £ £ s.
540 : 100 :: 194 8
9 yrs. : 1 yr.

$$£194\ 8\text{s.}\times\frac{100}{540\times9}=4\text{ p. c.}\quad\text{Ans.}$$

2.

		days.
5 for	5 days	= 25
6 „	$4\tfrac{1}{2}$ „	= 27
3 „	4 „	= 12
2 „	$3\tfrac{1}{2}$ „	= 7
1 „	3 „	= 3
1 „	2 „	= 2
1 „	$\tfrac{1}{2}$ „	= $\tfrac{1}{2}$
19		19)76·5

4·026315, average no. of days for those present at all.

$$\frac{76\cdot5}{25}=3\cdot06,\text{ average for whole class.}$$

3. 1 part out of 12 is dross, *i.e.* $\tfrac{1}{12}$;
∴ $\tfrac{100}{12}=8\tfrac{1}{3}$ p. c. Ans.

4. 7 + 11 + 14 = 32 parts.
$\tfrac{7}{32}$ of £42 = 9 3 9, A's share.
$\tfrac{11}{32}$ „ £42 = 14 8 9, B's „
$\tfrac{14}{32}$ „ £42 = 18 7 6, C's „

Grammar.

(*a*) The King Richard meant is Richard II., who lived 500 years ago.

(*b*) The pleasure which people take in disagreeing with one another is the reason of the changeful state of the world. Be-

cause at the present time every one is considered fit for nothing unless he is able, by fraud or deceit, to injure and oppress his fellow-man.

(*c*) The words of French or Latin origin are—*variable, dissension, collusion, oppression, causeth.*

(*d*) *What*—inter. pron. neut. sing. nom. to *makes.*
but—prep. gov. obj. case *lust.*
that—simple relative, neut. sing. 3rd pers. obj. gov. by *have.*
if—conj. gov. subordinate sent.
he—pers. pron. 3rd pers. sing. masc. nom. to *can.*
can—defect. verb, subj. mood, pres. indef. tense, 3rd pers. agr. with *he.*
do—trans. verb, strong conj. (*do, did, done*), infinitive mood, pres. indef. tense, gov. by *can.*
what—interrog. pron. neut. sing. nom. to *causeth.*
causeth—trans. verb, weak conj. indic. mood, pres. indef. tense, 3rd pers. sing. agree. with *what.*
this—demonstr. pron. neut. sing. obj. by *causeth.*
that—final conj. gov. subord. sent.
for—prep. gov. obj. case *lack.*
lack—abstr. noun. neut. sing. obj. by *for.*

(*e*)

Sentence.	Subject.	Predicate.	Completion.	Extensions
(*a*) For a man is held unable nowadays. (*Principal.*)	(For) a man	is held	unable	nowadays (*time*).
(*b*) But if he can do his neighbour wrong and oppression. (*Subord. to* (*a*) *conditional.*)	(But if) he	can do	wrong and oppression (*direct objects*).	his neighbour (*dative object*).

Geography.

1. Starting from *New York*, the first city in the States for population, wealth, and commerce, we proceed by rail through New Jersey, past *Trenton*, to *Philadelphia*, and traversing Pennsylvania, we continue west past *Harrisburgh*, and *Pittsburgh*, a great iron-manufacturing city. Through *Ohio* and *Indiana* we remark no important town until we reach *Chicago*, on L. Michigan. This is called the 'Garden City,' and has the greatest exports of grain in the world. We now enter the prairie-land of *Illinois*, and cross the Mississippi, by a bridge a mile long, into *Iowa*. We continue west past *Des Moines* to *Council Bluffs*, and beyond the Missouri we arrive at *Omaha*, the midway station of the Pacific Railway between New York and *San Francisco*. We proceed west through Nebraska, along the line of the *Platte*, and halt at *Cheyenne*, in *Wyoming*, across the hills and mountains of which we continue our route, and enter the Mormon territory of *Utah*, and at its chief town, *Great Salt L. City*, we find the Mormon head-quarters. Skirting the whole length of the *Gt. Salt Lake*, we soon reach the *Desert* of Nevada, and on the slopes of the *Sierra*, bordering on the State of California, we enjoy some splendid scenery. After briefly noticing the commercial town of *Sacramento*, we soon reach our destination, *San Francisco*, the most commercial town on the Pacific. Our journey has a length of over 3,300 miles.

Chili.—A country of South America, a long narrow strip between the Andes and the ocean. Chief town, *Santiago.*

Chimborazo.—The highest summit of the Quito Andes.

Juan Fernandez.—An island off the coast of Chili, the residence for four years of Alexander Selkirk, 'Robinson Crusoe.'

Magellan.—The straits between Patagonia and Tierra del Fuego, so named from their discoverer.

Monte Video.—A city on the northern shore of the Rio de la Plata, capital of Uruguay.

Quito.—A city on a plateau of the Andes, capital of Ecuador.

Rio de Janeiro.—A city on the S.E. coast of S. America, capital of Brazil—has a very fine harbour.

Tierra del Fuego ('Land of Fire.'—An archipelago, at the southern point of S. America. It has many active volcanoes.

Valparaiso ('Vale of Paradise').—The most commercial city of Chili.

History.

1. The invasion of the Romans introduced government and civilized manners. Great cities grew up, connected by excellent roads. Agriculture throve so much that Britain became one of the chief corn-exporting countries of the Roman Empire. The Romans left their mark on the land more than on the people.

On the other hand, the Angles, Saxons, and Jutes, who invaded the country from the north, were fierce heathen, who enslaved those whom they overcame, and drove the rest into the western part of the island. They spoke of the Britons as Welsh, while the Britons called them all Saxons. In short, they drove the inhabitants from the land, and occupied it themselves; eventually growing into the great English-speaking people, the greatest on the earth.

2.

	A.D.		A.D.
Harold II.	1066		
William II., Rufus	1087	to	1100
Edward II.	1307	,,	1327
Richard II.	1377	,,	1399
Henry VI.	1422	,,	1461
Edward V.	1483		
Richard III.	1483	,,	1485
Charles I.	1625	,,	1649

The character of Richard III. is generally represented as very bad. He is made not merely unscrupulous, as he most certainly was, but selfish, malicious, and very cruel. He was undoubtedly an able sovereign, and he certainly was at first very popular with the majority of his subjects. A terrible blot on his name is his behaviour to his nephews. It was believed at the time, that fearing the nation might consider their claim on the throne stronger than his, he sent murderers who smothered them in the Tower.

3. The first Act of Supremacy was passed in the reign of Henry VIII. in 1534, declaring the King to be supreme head of the English Church. The great Sir Thomas More, Chancellor after Wolsey, and Fisher, Bishop of Winchester, were the most distinguished of those who were executed for refusing to take the oath of supremacy.

The first Act of Uniformity of service was made in 1552, forbidding the use of any other religious rites than those set forth in the Prayer Book. The Princess Mary, afterwards Queen, declared that she would rather lay her head on a block and suffer death, than use the new service.

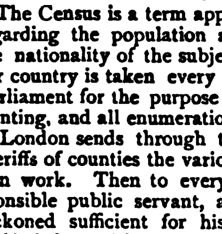
Another Act of Uniformity caused the secession of the Puritans, and a third Act, in the reign of Charles II., forced two thousand nonconforming ministers to withdraw from the Church. The most notable Dissenter at that time was John Bunyan.

Composition.

The Census is a term applied to the collecting of information regarding the population and employment of the people and the nationality of the subjects of the empire. The Census in our country is taken every ten years, and a sum is granted by Parliament for the purpose of defraying all expenses for paper, printing, and all enumeration accounts. The Home Secretary in London sends through the various official channels to the sheriffs of counties the various papers connected with enumeration work. Then to every registrar, or other recognized responsible public servant, a number of books and schedules, reckoned sufficient for his district, is transmitted. Having divided the parish or town into enumeration districts, the registrar, with the approval of the authorities, appoints enumerators, who distribute schedules to every householder the week before the day appointed for collecting the information. Having noted the name of the householder, the number or name of the house, and the number of windowed rooms, he leaves the schedule to be filled up by the head of the family. The responsible person of every house fills up the various divisions on the paper with the information required, and hands it to the enumerator on his return visit. Very complete arrangements are always made so as to include every one in the kingdom on a *certain night*, not even a tramp being omitted.

The value of such information to the Government is great, as it shows the number of men at their disposal, if necessary, for fighting purposes, the denseness of population in certain districts, the number of children of school age, the loss or increase of the population of towns and cities, the wealth of the nation, and other interesting and useful statistics.

Euclid.



1. Draw AR perpendicular to BC. Then because the angles ABC, BCA of the triangle BAC are equal to one right angle, as also the angles ABR (*i.e.* ABC), BAR of the right-angled triangle ARB; therefore the angle BAR is equal to the angle ACB; but the angle FBM is equal to the ABC, because FB is parallel to GC; for GA is in the same straight line with AC. Therefore

the angle BAR is equal to the angle FBM, and the angles at M and R are right angles, and the side BF is equal to BA. Therefore (I. 26) the triangles FBM, ABR are equal in every respect, and MB is equal to AR. In a similar manner it may be shown that AR is equal to CN, and thus MB, CN, being equal to the same line, AR, are therefore equal to one another, and MB is equal to CN—Q. E. D.

2 Prop. 7, Bk. II.

Algebra.

1. $24x^4-22x^2+5\,)\,48x^4+16x^2-15\,(\,2$

$$\begin{array}{r} 48x^4+16x^2-15 \\ \underline{48x^4-44x^2+10} \\ 5)\underline{60x^2-25} \\ 12x^2-5 \end{array}$$

$12x^2-5\,)\,24x^4-22x^2+5\,(\,2x^2-1$

$$\begin{array}{r} 24x^4-22x^2+5 \\ \underline{24x^4-10x^2} \\ -12x^2+5 \\ \underline{-12x^2+5} \end{array}$$

$\therefore\ 12x^2-5=$ G. C. M.

and dividing the terms of $\dfrac{24x^4-22x^2+5}{48x^4+16x^2-15}$ by $12x^2-5$,

the lowest terms are $\dfrac{2x^2-1}{4x^2+3}$

2. (1) $10x-y+3=20$ or $10x-y=17$ or $10x-y=17$,
$9y+x-2=27$ or $x+9y=29$ or $10x+90y=290$

$$\begin{aligned} 91y&=273 \\ y&=3; \\ \therefore\ x&=2. \end{aligned}$$

(2)
$$\begin{aligned} x^2+5x+147&=47x+235, \\ x^2-42x&=88, \\ x^2-42x+(21)^2&=88+441=529, \\ \text{taking root}\qquad x-21&=\pm 23, \\ x&=21\pm 23, \\ x&=44 \text{ or } -2.\quad \text{Ans.} \end{aligned}$$

3. Let $x=$ the number of hours he walked,

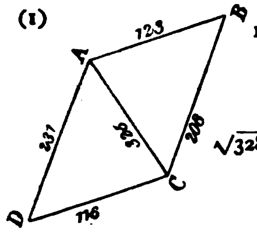
then $\dfrac{8\frac{3}{4}}{x}$ mls. = „ „ miles „ per hour;

$$\begin{aligned} \therefore\ x-1&=\frac{35}{4x}, \\ x^2-x&=\tfrac{35}{4}, \\ \text{completing the square}\quad x^2-x+\tfrac{1}{4}&=\tfrac{35}{4}+\tfrac{1}{4}=9, \\ \text{taking the root}\quad x-\tfrac{1}{2}&=\pm 3, \\ x&=\tfrac{1}{2}\pm 3, \\ x&=3\tfrac{1}{2}\ (\text{or} -2\tfrac{1}{2}), \end{aligned}$$

The meaning of the negative sign obtained in taking the square root of 9 is, that the square root of every quantity has both a positive and a negative sign, seeing that $+3\times+3=9$, and -3×-3 also $=9$.

Mensuration.

(1)



$\dfrac{123+208+325}{2}=328$, half sum of sides of ABC.

$$\begin{aligned} 328-123&=205 \\ 328-208&=120 \\ 328-325&=3 \end{aligned}$$

$\sqrt{328\times 205\times 120\times 3}=\sqrt{24206400}=$ 4920 sq. yds, area of ABC.

(2) $\dfrac{116+231+325}{2}=336$, half sum of sides of ACD.

$$\begin{aligned} 336-116&=220 \\ 336-231&=105 \\ 336-325&=11 \end{aligned}$$

$\sqrt{336\times 220\times 105\times 11}=\sqrt{853776}=9240$ sq. yds. area of ADC.

$$\begin{array}{rl} & \text{sq. yds.} \\ & 4920 \\ & \underline{9240} \\ 30\tfrac{1}{4})\!\!\! & 14160 \\ 40)\!\!\! & \underline{468}\ \text{po. 3 yds.} \\ 4)\!\!\! & \underline{11}\ \text{ro. 28 po.} \\ & 2\ \text{ac. 3 ro. 28 po. 3 yds.}\quad \text{Ans.} \end{array}$$

Music.

1.

2.

Diminished 7th   Augmented 2nd   Augmented 5th   Diminished 4th

3.

---o---

Publications Received.

Arithmetic—

(1) Sharple's Arithmetical Test Cards. Standards II., III., IV., V., VI. John Heywood.

Code Reform—

(1) Gladstone's Elementary Education Code. H. J. Infield.

French—

(1) Mast's French: Theory and Practice. Boulton & Co.

General Knowledge—

(1) Fuller's General and Bible Knowledge. Houlston & Sons.

Geography—

(1) John's First Book of Geography. Geo. Bell & Sons.
(2) Meiklejohn's Geographical Reader, I. W. & R. Chambers.

Grammar—

(1) Nesbitt's Grammarland. Houlston & Sons.
(2) Phillips' Illustrated English Grammar. G. Philip & Son.
(3) Imperial Grammar and Analysis. Thomas Murby.

Kindergarten—

(1) How the Human Plants are Trained in a Kindergarten. Sonnenschein & Allen.

Music—

(1) Pearson's National Method of Vocal Music. John Heywood.
(2) Pearson's Singer's Handbook to National Method. John Heywood.
(3) Potter's Church Choir Manual. Rivingtons.

Miscellaneous—

(1) Arnold's Method of Teaching the Deaf and Dumb. Smith & Elder.
(2) Schole's Child's Bible Expositor. John Heywood.
(3) Tamlyn's Missing Sheriff; and other Poems. John Heywood.

Natural Philosophy—

(1) Illustrations of Light and Heat; with Handbooks. W. & A. K. Johnston.

Reading—

(1) Mast's Phonic Method of Teaching Reading and Writing. Bean.

Science—

(1) Browne's Botany for Schools and Science Classes. Sullivan Bros.
(2) Dunman's Volcanoes and Coral Reefs. Griffith and Farran.
(3) Stoker and Hooper's Solutions to Examination Papers in Chemistry. Stewart & Co.

School Reward Books—Fiction—

(1) Claudine; or, Humility the Basis of all the Virtues. Griffith & Farran.
(2) Distant Homes; or, the Graham Family in New Zealand. Griffith & Farran.
(3) Fickle Flora and her Seaside Friends. Griffith & Farran.
(4) Good in Everything; or, the Early History of Gilbert Harland. Griffith & Farran.
(5) Pictures of Social Life. Griffith & Farran.
(6) William Tell: the Patriot of Switzerland. Griffith & Farran.

Writing—

(1) Murby's Imperial Copy-Books. Thomas Murby.

Publications Reviewed.

Science and Art Department. Chemistry, Organic and Inorganic, worked out in full as Models. By G. N. Stoker, F.I.C., F.R.M.S., and E. G. Hooper. London: W. Stewart & Co.

When the great French Academic Dictionary was being compiled, it is said that Baron Cuvier asked what definition of a crab they intended to give. 'A little red fish that walks backwards,' was the prompt answer. The baron mused a few minutes, stroked his beard, and then replied, 'Well, I have three objections only to take to this definition. In the first place the crab is not red, in the second place it is not a fish, and in the third place it does not walk backwards.' Almost the same remark might with safety be made in one or two places here. On page 35 we find a diagram, by courtesy so called, supposed to represent the manufacture of hydrochloric acid. Even admitting that it *does* represent this—and in denying this we should act with justice and follow Cuvier—we still have to complain that it is not a diagram, but only a half-confused smudge; and if we were to pass this by as a minor defect, we have simply nothing left. In fact, the figures are in general simply wretched, forlorn misrepresentations. Once, by way of variety, reference is made to a diagram by letters, and the letters are omitted in the diagram itself.

But it is not fair to lay at the door of the authors things for which publisher and engraver are jointly responsible. Let us pass on accordingly to the subject-matter itself. As before, we have some little complaint, but it is comparatively insignificant. We are told that Nickel, for instance, is a white metal resembling silver. To this we object that Nickel is not white, and that it does not in the slightest resemble silver. True, our authors' remarks apply perfectly to Electrolytic Nickel to which a high polish has been given; but it is no more fair to use this as a general description of the metal than it is fair to take gas-coke as a specimen of carbon, and thence describe the appearance of charcoal. On page 44, in the Inorganic part, we are asked for several methods of separating Manganese and Iron. We read through four methods, all more or less practicable, but fail to meet with the only one which the manufacturer finds it profitable to employ, obtaining the mixed sulphates, and then strongly igniting, so as to reduce the $Fe\,SO_4$ to $Fe_2\,O_3$, leaving this insoluble residue after treating with $H_2\,O$ and dissolving the $Mn\,SO_4$. Or, again, we have a mixture of $Ba\,CO_3$, $Na_2\,SO_4$, $Cu\,Cl_2$, $Zn\,Cl_2$, and $Mg\,Cl_2$ given, and are required to separate and distinguish the constituents. We might, at any rate, have hoped to separate the $Ba\,CO_3$ at once, by dissolving all the rest in water. As it is, $H\,Cl$ is poured in, and the acutest chemist in the world would, we think, be unable to say whether it was $Ba\,CO_3$ and $Mg\,Cl_2$ or $Mg\,CO_3$ and $Ba\,Cl_2$. Throughout this and similar questions, in fact, we are accurately shown that various acids and various bases exist in our mixture, but no hint, not the shadowiest or most imperfect, is given as to how these bases and acids combine. Even when all the substances are soluble, in nine cases out of ten such hints might have been given without taking more than a few lines.

But, as we said, our grounds for complaint are fewer than our grounds for congratulation. South Kensington theories seem grooved into the whole science. Graphic formulæ are managed with wonderful skill. Complex compounds, such as Meerschaum ($Mg_2\,H_4\,Si_3\,O_{10}$), Aluminic Pyrophosphate $\{(Al_2\,O_6)_2\,3P_2\,O_3\}$, Apatite ($Ca_5\,O_{12}\,P_3\,F$), yield as readily as the simplest. Even in smaller points, such as writing P_4 instead of $4P$, our authors are careful to adhere to rule.

Finally, if it be on the whole deemed advisable that a Key to the Science and Art Papers in Chemistry should be furnished, for the purpose, we presume, of model answers, we do not think that, taking into account the great difficulty of writing such a book so as to please everybody, the work could be much more ably done.

For facility of reference an index is added, with the result of making the book available to those who use the ordinary text-books.

Grammar, History, and Derivation of the English Language. By Rev. Evan Daniel, M.A. In Two Volumes. I. Accidence, Parsing, Analysis, and Syntax. II. History and Derivation. 135 pp. London: National Society's Depository, Westminster, 1881.

We should not think it out duty to give anything but praise to this work, but that the author himself invites suggestions and corrections, so that he will not misunderstand our following remarks. The book is mainly intended for 'students in Training Colleges, the upper forms in Secondary and High Schools, and candidates for the University Local Examinations, and for the Matriculation Examination of the London University.' We read it carefully through with a view to its adaptability to the last object, and rise from the perusal with very considerable satisfaction. Nevertheless we noted one or two points for remark. 'Dr. Donaldson used to say to his pupils,' we are told in the Preface, 'whenever you come across an ingenious derivation, distrust it.' We do not intend to quarrel with the doctor, but we do think that if this rule is quoted it should be adhered to more rigidly than it is. *Hundred*, we read, is made up of *hun*, a contraction of the Gothic *taihun* (= ten), and *raed*, an old Swedish word meaning 'a reckoning up to ten.' The ingenuity of this is marvellous, but perfect credence is notwithstanding claimed for the result. What the real derivation of *hundred* is is not much to the point, even if it be a worthy cause for spending time. Latham puts it down to old Latin *hundredum*, leaving us precisely where he found us, for what on earth does *hundredum* claim kinship with? Besides which, Dr. Donaldson might well have added a second canon, 'Most words put down to Low Latin are shams and deceivers,' for the general rule with some philologists is to seize this language, as the one most passive under mutilation and injury, and father upon it any miserable little orphans who can find shelter nowhere else.

In the case of disputed derivations, again, both claimants might surely have been allowed standing ground. We confess that we have been always brought up to regard a king as the cunning, the wise man. Now, however, he assumes a fresh garb, as the *cyn-ing*, the son of his tribe. Bachelors and cowherds, and ladies and bread-kneaders, are identified in a manner which, if it does nothing else, shocks ancient prejudices.

We will name one other thing only, and that is the theory of the formation of the past tense. 'I loved,'

Mr. Daniel thinks, was once 'I lovedede' = 'I love-did.' We confess that there are great names in support of this view, but there are more and greater now against it. Dr. Weymouth makes the amusing remark, that 'if -de = did, dy-de = do + dy-de = do + do + dy-de, and so on *ad infinitum*.' And he goes on pertinently, and to our mind conclusively, 'There scarcely seems room to doubt that the *d* of the past indicative is the same as the *d* or *t*, and therefore *n* also, found in so many languages in the past-participle and several quasi-participial forms; and for these we find the meaning of *did* unsuitable. . . . . . Just as the hissing *s* appended to the Greek *ἐν* or *πρό* conveyed the idea of motion, *ἐνς* or *εἰς* indicating a motion that results in the position *ἐν*, and *πρόν* indicating a motion that results in the position *πρό*; so when an effort has been made and the work is achieved, a sense of relief is expressed by the explosive *d* or *t* or more prolonged dental *n*.' Not only in this, but in many other questionable points, such as the derivation of *shall*, our author has followed Dr. Morris, while he might at least have mentioned the views of such a weighty opponent, who now and then differs prominently from him.

Creditably and accurately done as is the first volume, the second is even more so. Now and then, perhaps, the derivations are far-fetched; now and then the arrangement is confused; but as a whole the book is successful, and this is all the more creditable, inasmuch as it is the first of its sort in the field. At times, too, we come upon things so obvious as to be almost truisms, certainly to need no special mention. No one could ever doubt that *Jesuit* and *Jesus*, *Jeremiad* and *Jeremiah* are closely akin, though it may fairly be doubted whether *Jeremiad* is any more a naturalized English word than several curious specimens originated by Carlyle of less obvious origin.

In conclusion, we will express our unfeigned satisfaction. We have no hesitation in saying that the book contains enough amply to enable the student to pass the Matriculation well, and we doubt whether this can fairly be said of Mason or Morris.

French, Practice and Theory; or, A New Practical and Natural Method of Learning to Read, Speak, and Write the French Language. By G. C. Mast. Third Edition. London: Joseph Boulton.

Of all the many French books which it has been our fortune, or misfortune, to notice during the last six months, this is pre-eminently the worst. The title contains six advantages of Mr. Mast's scheme; we have, therefore, six indictments against the said title. The idea is not new: Ollendorff tried it some time ago, and now languishes in second-hand book-stalls—nowhere else. The idea is not practical; it is not natural. Can it be for an instant imagined that to learn to translate babyish nonsense, fit only for consignment either to the waste-paper basket or the nursery, can ultimately lead to any good results? Take a specimen of what, if we may trust the Preface, 'young children, equally well as (*sic*) elder ones, should constantly repeat, as repetition is the only means of acquiring fluency:'—'Here is a box. If you please, what is in the box? Sugar plums. Eat it. Shut the box.' It is to be hoped the child has the sense to shut the book as well.

Again, the title informs us that Mr. Mast is competent to teach us how to read French. Even this we doubt; while we are certain that his book, at all events, is utterly incompetent for the task. Fancy a Racine or Molière made up of little sentences such as we quoted; and we really scarcely ever rise higher than an acquaintance with this nonsense.

In our opinion, again, it is equally unfitted to teach how to write French, inasmuch as even a Frenchman would count the most sensible model sentences in this book a compound of nonsense and wholly unnecessary sense. Sixthly and finally, it is an utter failure in pronunciation. Again and again through these columns have we expressed our abhorrence of any attempt to teach pronunciation on paper. It cannot and never will be successfully done. Any approximation thereto, moreover, is simply horrifying. Take the following choice morsels from the pronunciation-table given on p. 46:—

boîte	becomes	bo-ah-tt.
fils	„	fiss, which is certainly utterly wrong.
oreille	„	o-rā-ye, which conveys no notion at all of the real difficulty.
excuse	„	eks-keese, with the additional information in a foot-note that this last business must be done with a 'rounded mouth' so as to hit the mark exactly.

We have accused this book in a very comprehensive fashion, but we are sure that no competent judge will consider that our accusations are far-fetched or unnecessary. Indeed, we have only to open the book at random to double the number. Surely, an author should try to speak the truth on his first page, whatever becomes of the fiftieth. Yet we find a list of sixty words spelt alike in English and French, though by no means in all cases of precisely the same significance. This list is headed by the remarkable statement that all in it are 'names of male beings, or considered as males.' Here are a few examples of what Mr. Mast considers as male beings; or thinks, at all events, that the French have been deluded into thinking of as male beings: *arsenic*, *canal*, *fruit*, *vase*, *vice*, *village*. Has our author never heard of a neuter gender? If he has, then it is simple barefaced nonsense to talk of the French as if they had no discrimination. If he has not, we leave our readers to judge of his capabilities to lead others.

The title does give us an idea that we may get a formal sort of introduction to grammar. This is a notion, however, which we soon have to discard. There is absolutely no vestige of any systematic or orderly treatment—nothing but a few detached notes on verbs here and there. It is probable, of course, that Mr. Mast himself is not unacquainted with the subject. It is certain that he is utterly unable to prove his knowledge by his work, if, by a stretch of imagination, these hundred pages may be so called.

But we must have done. The book was not worth half the space. If any one desires to become acquainted with the method in which we advise him not to write a French book, if, indeed, any infatuation should finally persuade him that the Fates mean him to write at all; if any one desires to sound a depth of stupidity of which, in print, at all events, we should have doubted the existence,—let him devote all his spare energies to the perusal of this book. If he desires to know French, let him keep his distance from Mr. Mast.

A Sequel to the First Six Books of the Elements of Euclid, containing an Easy Introduction to Modern Geometry. With numerous Examples. By John Casey, LL.D., F.R.S. Hodges, Dublin; and London: Longmans, Green.

Professor Casey's aim has been to collect within reasonable compass all those propositions of modern geometry to which reference is often made, but which are as yet embodied nowhere, save in scattered notes to Euclid, or surrounded with very much more advanced work, which the elementary student, at all events, has no very definite prospect of ever putting into practice. It differs from the more elaborate works of Mulcahy and Townsend, in that any one who has thoroughly grasped Euclid merely, is fit for its perusal; while, at the same time, we shall adduce examples to prove that the results attained by these more limited tools are by no means small or inconsiderable.

The book is divided into six sections, corresponding to the various Books of Euclid. Excepting the generally confused look of the diagrams and print, this is almost the only objectionable point in it. Though one would expect that an arrangement of this sort would result in an orderly and systematic treatment of the subject, the result is precisely the opposite. And the confusion introduced by this method of treatment is very much heightened by an attempt to be too compact. Four propositions and thirteen corollaries do seem rather full measure for three pages, and the repetition of freaks such as these cannot but give the reader a general impression of weariness, inasmuch as his eye will absolutely refuse to grasp so much matter at once.

But if we are forced to object to the arrangement of the book, we can unreservedly give the highest possible praise to its matter. In most cases the proofs are extraordinarily neat. Now and then, indeed, the author is led to give to a proof of his own a preference which others would, perhaps, have refused it. But this is rare, and the fault in so doing is almost condoned by his, in most cases, adding other proofs.

As examples of peculiarly praiseworthy work, we cite Prop. 14, Book I.: 'To inscribe a square in a triangle,' for which a construction is given which, as is pointed out, equally well applies to *escribing* a square; Prop. 11, Book II., a general theorem concerning Centre of Mean Position; Prop. 17, Book III.: 'To describe in a given triangle, a triangle of given species, whose area shall be a minimum,' or Professor Williamson's proof of Prop. 18, given in a note on p. 48. The treatment of the Nine-Points Circle, however, would bear improvement. It does not commence with showing us how to find the centre, and we think it should do so.

The Notes to Book VI. are the most satisfactory. Feuerbach's, or, as we have been accustomed to call it, Terquem's Theorem (the nine-points circle touches inscribed and escribed circles), is favoured with two or three proofs, all of which are neat. Dr. Hart's extension of it, too, is extremely well proved.

The Method of Reciprocal Polars is touched on, but of course not to any great extent, inasmuch as it is of very small utility as far as circles and lines are concerned.

Feuerbach's Theorem would have supplied a neat proof of the problem: 'To describe a circle touching three given circles,' inasmuch as given the escribed circles, it is not at all hard to find the primary triangle to which they are escribed, and to draw the nine-points circle of this triangle. Nevertheless, this problem is solved by Professor Casey in two really good ways—one of which is original, and both deserve especial commendation.

Pascal and Brianchon's well-known theorems are likewise applied as far as they can be to circles.

Finally, in Section VIII. of this book we have a collection of a hundred miscellaneous exercises, three of which, being important, are solved. These include—

Malfatti's Problem: To inscribe in a triangle three circles which touch each other, and each of which touches two sides of the triangle.

Miquel's Theorem: If the five sides of any pentagon be produced, forming five triangles external to the pentagon, the circles described about these triangles intersect in five points which are concyclic.

We shall have given sufficient commendation to the book when we say that the proofs of these and equally complex problems, which we used to shudder to attack even by the powerful weapons of analysis, are easily and triumphantly accomplished by Pure Geometry.

After showing what great results this book has accomplished in the minimum of space, it is almost superfluous to say more. Our author is almost alone in the field, and for the present need scarcely fear rivals.

Elementary Notions of Logic: Being the Logic of the First Figure, designed as Prolegomena to the Study of Geometry. By Alfred Milnes, M.A. (Lond.). London: W. Swan Sonnenschein and Allen.

In the midst of a deluge of books on this subject, our author finds it very necessary to give cause for his existence in a somewhat lengthy preface. In order to get at once an idea of the scope of the book, and a notion as to why we have it at all, let us endeavour to follow him. 'Too often our elementary text-books resemble rather the lecture-notes of a clever student preparing for an examination than the thorough rounded work of the highly-trained teacher.' This is true enough. All it means is, that no professor ventures to write in his book all that he would have dictated to his class—leaves a good deal, in fact, to be supplemented by the pupil's private ingenuity. And such a course is, it seems to us, very advisable. 'The result is, that the student finds himself bewildered by an immense amount of matter crammed into a small compass, and he must needs learn his subject before he can understand his book.' And as in most cases of private study, it is, to say the least, doubtful whether a subject can be learned without a book—we see at once the true cause for the publication of this book.

There is not the slightest doubt in our minds that, to some little extent, our author has exaggerated the magnitude of the evils which he has arisen to remedy. This we can easily pardon, and are now free to bestow unmixed praise on the execution of the somewhat difficult design.

The ground covered is necessarily small, because we are confined to the First Figure. Nevertheless, the hope expressed in the Preface, that the knowledge should be sound and competent, as far as it goes, is adequately realised. The chief subjects treated of are

Denotation and Connotation, Genus and Species, Propositions, Quality and Quantity, Oppositions and Conversions of Propositions, Inference and other Modes of Demonstration, and Definition. Throughout the plan of representing syllogisms by parallel lines, and thus testing their reliability, is adopted. At first, indeed, besides this plan, we have the other common one, of circles within circles; but this is finally abandoned as being too cumbrous, and not general enough. Moreover, all places where an important connection with Euclid occurs are emphasized, so that they cannot well escape notice.

There are two classes of people to whom this book will be of especial service—those who have found a difficulty in falling in with Euclid's method of managing matters, and those who have found the ordinary logical text-books too condensed. We take the author's word that such people exist; though, without that word, we might have doubted it. Admitting this, we record our conviction that the task could not have been better done.

A Manual of Spelling and Dictation. In Two Parts. By Joseph Hassell, A.K.C. London: Walker & Co.

These two little books will be found very useful by all who adopt them. They contain a series of well-chosen 'Home Lesson' exercises, special prominence being given to 'catchy' words, and to the words which, though sounded alike, are spelt differently. The books have a neat appearance, and are well stitched.

Sharples' Arithmetical Test Cards. In Five Packets, for Standards II. to VI. London: John Heywood.

We are glad to be able to recommend these five packets of cards. The selection of problems struck us as being particularly happy.

Johnston's Illustrations of Light and Heat. Sheets III. and IV. (Heat), with Handbooks. London: W. & A. K. Johnston.

Worthy of the high praise which we bestowed on their predecessors in the same excellent series of illustrations.

The Missing Sheriff: a Mystery of Chaucer's Time. And other Poems. By Hartley Tamlyn. London: John Heywood. 1881.

It is the duty of every man or woman who sits down to examine a new work to do so with the intention of criticising that work in a fair and generous spirit, and of endeavouring to discover not so much its faults as its excellences. More especially is it to be noted that if the book is the first production of its author, it is the critic's duty to do his utmost to discover what promise the author gives of future excellence; for promise is to be expected rather than performance in a primary work.

We presume that the volume before us is the first production of Mr. Hartley Tamlyn. Indeed, he tells us, in an address to the reader, that this is his primal effort. In the same address he begs his critics to remember that whatever they may say of his book, however they may review it in a hostile manner, he will not take their strictures as personal offences, but will rather regard them as incitements to better things.

Having thus been assured that our author is open to criticism in its truest sense, we proceed to examine his work, hoping to find in its pages some of that verse-writing which may be called Poetry.

Mr. Tamlyn has filled the first sixty-five pages of his work with the poem which gives the title to the whole. It is written in a smooth, easy-flowing octometer, which at length grows monotonous, just as the pleasant babble of a stream becomes wearisome from its very sameness. The poem has, here and there, fair descriptive passages, but we think that it has no especial merit save that of an easy versification. Its length is a great hindrance to its success. If only our young poets would remember the simple rule that quality is better than quantity, they would produce much more satisfactory work.

Of Mr. Tamlyn's shorter poems we can speak with more praise, and we can most honestly assure him that he would have been much wiser if he had published only the 'other poems.' Although there is a certain crudeness and juvenility about these miscellaneous verses, still there is something in them which is pleasing, and which shows that their author is the possesser of some fancy, and has a faculty of expressing himself in a fluent and musical fashion. As a specimen of what he can do we extract the following poem, or rather sonnet, merely remarking that Mr. Tamlyn would have done better if he had avoided the use of the heroic couplet at the end:—

'TO LONGFELLOW.

'Thou new-world Bard, whose touching melodies
Across the ocean's changeful face have come,
To cheer and teach us in our English home
By every charm that woven in them lies;
Brother in spirit, excellor in song,
The mystic music of thy varied lays
Has charmed away the dulness of our days,
And captive led too willing slaves along.
Time passes on from Spring to Autumn brown,
The Winter, hoary, sere, to them takes place;
But mayest thou, now ending mortal race,
Ne'er be assailed by wintry storm-blast's frown;
May green poetic laurels ever shed
Tranquilest glories round thy patriarch head!'

In parting with our new author and his book we would give him a word or two of advice. We would beg him to remember that it is only with *care*, and *thought*, and *study* that any man—however much of the divine afflatus he may possess—can become a real poet, not to say a great one. We would advise him also not to take Lord Byron as a model, as he seems to be in danger of doing at present, for no worse model could possibly be found. Great and noble as the 'greatest Englishman of the nineteenth century' was, and fine and powerful as his works are, yet it is nearly impossible to imitate him, and those who do so will find that they will succeed in making a capital copy of his *bad* points, and fail in reproducing his *good* ones. We would earnestly recommend Mr. Tamlyn to study the works of the masters of our Natural school of poetry, and to read attentively the best poems of Wordsworth, of Tennyson, and, coming into recent times, of Lewis Morris; and not to think of publishing any more books until his style is fully formed. Let him remember that he who has the power of writing poetry possesses a very noble gift indeed, and one for which he will be held accountable. Let him remember that poetry in its truest sense is the

expression of nature and of life, and that it is the mission of a poet to sing of all that is bright and beautiful in the life we live and in the scenes which lie about us, and to endeavour—and surely this is a noble work—to make happier and better the crowd of humanity by which he is surrounded.

Man: his Frame and Wants. By the late Charles Baker. London: *The Systematic Bible Teacher* Repository.

This comprehensive little work is the first of a popular series for school and home use, and consists of a number of lessons upon the human frame and its various requirements. Chapters upon anatomy are followed by others upon food, clothing, dwellings, education, etc., each comprising a considerable amount of information. Although scarcely suited for a class-book for the use of children, this volume will be found of service to teachers in preparing lessons for their pupils.

Animals: their Nature and Uses. By the late Charles Baker. London: *The Systematic Bible Teacher* Repository.

This volume forms the second of the above series. Unfortunately, in bringing out a new edition of this work, the contents have not been revised and corrected up to the present state of scientific knowledge, and we are in consequence presented with many of the errors of the time in which the volume originally appeared. Some of the statements are of a very misleading character, and are entirely opposed to the teaching of the other text-books at present in use. For instance, on page 24 we are told that the bat may be considered as one of the links of nature, combining the characteristics of the mammals with those of the birds. Such an assertion speaks for itself. Farther on, we find the common blindworm included among the snakes. Again, early in the work, the luminosity of the sea is referred to the agency of the radiates, or starfish, and on page 14 the food of the gluttons is stated to be chiefly of a vegetable nature.

Many of the illustrations, too, are exceedingly crude and imperfect. That of the ape, on page 6, reminds one of the woodcuts in the natural histories of a couple of hundred years since, and the eland, on page 12, appears to have been drawn from one of the animals in a child's 'Noah's Ark.' The whale, on page 19, is almost unrecognisable, being adorned with a pair of huge eyes and ears, and a few pages farther on, the duck-billed platypus is represented with a tail resembling a fox's brush. Passing to the insects, too, in a drawing of the bee, showing the three sections of the body, the third pair of legs is represented as springing from the abdomen.

In spite of these and other errors, however, there is a good deal of sound information in the book, which, like the last, is more suited to teachers than to pupils.

First Book of Geography. (British Isles.) By the Rev. C. A. Johns. **(Bell's Books for Young Readers.)** George Bell, York Street, Covent Garden.

This little book is of the right educational stamp, and is a most refreshing relief from the repulsive collection of names and places, the committal of which to memory is supposed by some writers to constitute a knowledge of Geography. Mr. Johns possesses the happy gift of knowing how to write for children without being childish, and renders the acquisition of knowledge easy as well as attractive by the true educational plan of letting the idea precede the term. A few of the opening sentences in his capital little book will show teachers and parents that this is the sort of way in which geographical knowledge can best be read about:—'If you walk but a little way into the country, you must see that the ground or *surface* of the earth is not everywhere the same. A piece of ground which is shut in all round, and has plants growing in it, is called a *garden* or *field*. If the field has grass growing in it, it is called a *meadow;* if cows and sheep feed in it, it is called a *pasture;* but if the grass has to be made into hay, it is called a *hay-field;* and fields in which corn or turnips are grown, are called *corn-fields* or *turnip-fields*. A piece of ground covered with large trees is called a *wood;* a very small wood is called a *grove;* a very large one a *forest*. If the trees in a wood are cut down before they are large, and let to grow again, then the wood is called a *copse*. If fruit-trees grow in a field, it is called an *orchard*.'

In this pleasant way Mr. Johns leads children to notice what they see around them, to understand the common and familiar names, and thence by a sure process of induction to associate further geographical knowledge with the like method of observation. After thus pleasantly talking about the most striking features of land and water, the most salient features of modern British civilization are given and lucidly contrasted with those of former periods. A short account of the principal English counties makes up the mass of the succeeding pleasantly-written pages, followed by a brief description of Ireland, Scotland, and Wales. Interspersed are useful and attractive chapters on the Mariner's Compass, Mines, Government, Banks and other commercial arrangements, and the leading features of the vast metropolis. With so much to approve we are sorry to see anything in the way of imperfection in this useful little book. But Mr. Johns does not seem to be aware of the light which Dr. Nicholas, Pike, and others have thrown upon the civilization of the ancient Britons, and gives the usual worn-out statements about their being mere hordes and half-naked savages, together with the common twaddle about the ignorant and cruel superstition of the Druids. Mr. Johns, however, cleverly avoids falling into the common error of describing the Britons as being driven out of the country by the Teutonic invaders:—'You will read by-and-by, in books of history, who these nations were; but I may tell you that their names were Danes, Saxons, and Normans, and that in time they became so mixed up with the Britons that it was not possible to tell one from another.' This is well put, and corrects a widespread popular error. We also question the propriety of attributing sickness to the pleasure of God, when if people would only attend to God's laws much sickness would be avoided. We are no more justified, generally speaking, to say that it pleases God to afflict people with sickness than that it pleases Him to drown those who throw themselves into the water, or burn those who rush into the fire. This, however, is only a mere passing expression on the part of Mr. Johns, and not prominently thrust forward. The same reticence in avoiding sacred references might lead to the reconstruction of the following pas-

sages in regard to the rising of the tides:—'You might be afraid that it would rise so high as to sweep away the houses and people; but God has fixed the bounds, which it can never pass.' Now as the tide often does 'rise and sweep away houses and people,' children ought to be taught that this is owing to people not taking sufficient precautions against storms and floods, which are as much portions of Divine arrangement as the ordinary rise and fall of the water. So far from the sea never passing some supposed bounds, it is continually encroaching on the land in some parts, receding in others, and washing the shore with incessant changes. Not only the yielding clay and chalk are sapped away by the waves, but even hard rocks in time yield to its incessant action, while on the other hand sand and shingle are deposited, as at Bramber and Hythe, by which a new coast-line is formed, and places formerly washed by the sea are now far inland. Mr. Johns is as capable of dealing with these important geographical facts as with others, which in his hands are rendered unusually attractive and instructive. Altogether this book of no less than 300 pages of nice large readable type and suitable illustrations is a capital shilling's worth, admirably suited for supplementary reading lessons to the junior and middle portions of schools.

Murby's Imperial Copy-Books. No. 6½. London: Thomas Murby.

This new number in Mr. Murby's well-known Imperial Copy-Books is a valuable addition to the series. To prevent the possibility of the young writer ignoring the lithographed headlines, there are no less than four separate copies on each page. The writing is round and beautiful. When neatly done, this copy-book will form an exceptionally good one for presentation to Her Majesty's Inspector at his annual visit.

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Query Column.

*** *Communications for this column must reach the Office not later than the 15th inst., and should be addressed,* 'THE QUERY EDITOR' of the *Practical Teacher,* Pilgrim Street, Ludgate Hill, London, E.C. *Correspondents must in all cases remember to give their true names, not necessarily for publication, but as a guarantee of good faith, and for facility of reference.*

We are now receiving such a number of Queries that we shall be obliged for the future to limit each correspondent to ONE *question. When more than one are sent, we shall, if possible, give slight hints for the solution, or solve the most difficult only. All, however, who adhere to our rule may be sure of having their difficulties fully explained.*

We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

1. DELMER.—Parse, 'How do you do?' The first *do* is the ordinary auxiliary (equivalent to Latin *facere*); the second is the only surviving form of the Anglo-Saxon *dugan*, which is equivalent to the Latin *valere*. The original verb remains in Danish in the slightly altered form *duger*. For further information, see Latham's Dictionary, Morris' Handbook, or any standard work.

2. FARMER, Muir of Ord.—You will find Crosby Lockwood's *Text-Book of Agriculture* very useful, and quite sufficient for the Honours Examination. Messrs. Lockwood and Co's address is 7, Stationers' Hall Court, London, E.C.

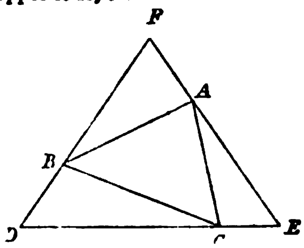
3. O. DEXTER, Marple.—The perpendiculars from the angular points upon the opposite sides of a triangle meet in a point.

Let ABC be the triangle, and through the vertices draw lines FAE, ECD, DBF parallel respectively to the opposite sides, forming a fresh triangle DEF. Then FACB is a parallelogram $\therefore$ FA=BC, so also AE=BC. Hence the line FE is bisected in A; similarly ED is bisected in C, and DF in B. Also any line perpendicular to BC is perpendicular also to FE, which is parallel to BC. Hence the problem reduces itself to proving that the perpendiculars to the sides of the triangle DEF through their middle points meet in a point. Let AP and BP be two of these perpendiculars, and join CP. (N.B.—The figure will be easiest to draw if all the angles of ABC are supposed acute.) We will prove that CP is perpendicular to ED. Join DP, EP, FP. Then in the triangles DPB, PBF, DB=BF, BP common, $\angle$FBP=rt. ang. $=\angle$PBD, $\therefore$ (Euc. i. 4) FP=DP. Similarly, also, FP=EP $\therefore$ DP=EP, and DC=CE, and CP is common to DPC, PCE $\therefore$ (Euc. i. 8) $\angle$DCP$=\angle$PCE=rt. angle.

P is, of course, the *orthocentre* of ABC, and the *circumscribed* centre of DEF.

4. O.—Show that the altitude of the greatest equilateral triangle that can be circumscribed about a given triangle is $\left\{a^2+b^2-2ab\cos\left(\frac{\pi}{3}+C\right)\right\}^{\frac{1}{2}}$ (Todhr., *Differential Calculus*).

Let ABC be the triangle, and DEF the circumscribed equilaterial triangle; DEF being placed round ABC, so that D is opposite A, etc.



CBD$=\theta$. CAE$=\phi$.

$$\frac{CD}{CB}=\frac{\sin\theta}{\sin 60}\therefore CD=\frac{2a\sin\theta}{\sqrt{3}}$$

So also $CE=\dfrac{2b\sin\phi}{\sqrt{3}}$

But $FAB=\pi-A-\phi$
$FBA=\pi-B-\theta$

$$\therefore BFA=60^\circ=\pi-(\pi-A-\phi)-(\pi-B-\theta) \\ \theta+\phi-C$$

(1) $\therefore \theta+\phi=\left(\frac{\pi}{3}+C\right)$

Also since DFE is a max. DE must be a max.

$$\therefore a\sin\theta+b\sin\phi \text{ is a max.}$$

Differentiating, and using the notation of differentials,

$$a\cos\theta.\quad d\theta+b\cos\phi.\quad d\phi=0.$$

Also differentiating (1)

$$d\theta+d\phi=0,$$

(2) $\therefore a\cos\theta=b\cos\phi$, on eliminating the differentials.

Now altitude of DFE $=a\sin\theta+b\sin\phi$.

$$=\sqrt{a^2\sin^2\theta+b^2\sin^2\phi+2ab\sin\theta\sin\phi}$$
$$=\sqrt{a^2+b^2-a^2\cos^2\theta-b^2\cos^2\phi+2ab\sin\theta\sin\phi}.$$

Now from equation (2) $a^2\cos^2\theta=ab\cos\theta\cos\phi=b^2\cos^2\phi$

$$\therefore \text{altitude}=(a^2+b^2-2ab\cos\theta\cos\phi+2ab\sin\theta\sin\phi)^{\frac{1}{2}}$$
$$=\{a^2+b^2-2ab\cos(\theta+\phi)\}^{\frac{1}{2}}$$
$$=\left(\text{by (1)}\right)\left\{a^2+b^2-2ab\cos\left(\frac{\pi}{3}+c\right)\right\}^{\frac{1}{2}}$$

It is of course evident that the altitude might equally well be $\left\{b^2+c^2-2bc\cos\left(\frac{\pi}{3}+A\right)\right\}^{\frac{1}{2}}$, or the similar expression in c, a, and B. These three solutions are all different, or there are three maxima values. The condition for a unique solution is seen to be

$$c^2+2ab\cos\left(\frac{\pi}{3}+c\right)=b^2+2ac\cos\left(\frac{\pi}{3}+B\right)$$
$$=a^2+2bc\cos\left(\frac{\pi}{3}+A\right)$$

5. Find what sector must be taken out of a given circle in order that the remainder may form the curved surface of a cone of maximum volume, α is the angle of sector, r radius of circle, $(2\pi-\alpha)r$ circumference of base of cone, r slant height

$$\therefore r\sqrt{1-\left(\frac{2\pi-\alpha}{2\pi}\right)^2} \text{ is height}$$

$$\therefore \text{volume}=\frac{1}{3}\frac{(2\pi-\alpha)^2r^3}{4\pi}\sqrt{1-\left(\frac{2\pi-\alpha}{2\pi}\right)^2}$$

$$\therefore (2\pi-\alpha)^4\{4\pi^2-(2\pi-\alpha)^2\} \text{ is man.}$$

Differentiate with regard to $2\pi - a = y$, $16\pi^2 y^3 - 6y^5 = 0$,

$$2\pi - a = \sqrt{\frac{8}{3}}\,\pi\,; \quad a = \pi\left\{2 - \frac{2\sqrt{2}}{\sqrt{3}}\right\}$$

6. If normal to curve $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ make an angle ϕ with axis of x its equation is $y \cos \phi - x \sin \phi = a \cos 2\phi$

$$\left(\frac{dF}{dx}\right) = \frac{2}{3}x^{\frac{1}{3}}\,; \quad \left(\frac{dF}{dy}\right) = \frac{2}{3}y^{\frac{1}{3}}$$

$$\therefore \text{ equation is } (y - y_1)\, x_1^{\frac{1}{3}} - (x - x_1) y_1^{\frac{1}{3}} = 0$$

$$\therefore \frac{y_1^{\frac{1}{3}}}{x_1^{\frac{1}{3}}} = \tan \phi\,; \quad y_1 = x_1 \tan^3 \phi$$

$$\therefore \frac{y_1}{\sin^3 \phi} = \frac{x_1}{\cos^3 \phi} = + \left\{\frac{y_1^{\frac{2}{3}} + x_1^{\frac{2}{3}}}{\sin^2 \phi + \cos^2 \phi}\right\}^{\frac{3}{2}}$$

$$= -a \text{ (refer to geometry of curve) } \therefore y_1 - x_1 \left(\frac{y_1}{x_1}\right)^{\frac{1}{3}}$$

$$= -a\,\{\sin^3 \phi - \tan \phi \cos^3 \phi\}$$

$$= +a \cos 2\phi. \quad \text{Whence the answer.}$$

7. A SUBSCRIBER, Poplar.—In what propositions in Euclid's first and second books are the axioms used? Take any standard Euclid, Todhunter's say, and glance down the margin of the page for the references. We cannot answer questions which you can find answered in any book.

8. 'HABITANS IN SILVA.'—You have confounded *Stocks* with *Sterling money*. £6947 18s. 4d. is the *sterling money* invested in the $90\frac{5}{8}$. If this sum be changed into *Stock*, then we have £7666 16s. 8d. of *Stock* in the $90\frac{5}{8}$.

$$\frac{£6947 \text{ 18s. 4d.} \times 100}{90\frac{5}{8}} = £7666 \text{ 16s. 8d.}$$

9. 'HEAD MASTER,' Mansfield.—If you cannot get the information you want in Crosby Lockwood's *Text-Book*, or some other standard authority, we think your best course would be to consult some neighbouring farmer, who would almost certainly be able to help you. We do not feel justified into extending our already swollen column by introducing matter which can at best have a very special interest only.

10. W. E. B., Stockport.—Get Dr. Marse's *General Musical Instruction* (Novello, 6s. 6d.), or Dr. Crotch's *Elements of Musical Composition* (Novello, 4s. 6d.), and Bannister's *Music* (Bell, 5s. 6d.).

11. 'DIEU ET MON DROIT.'—Handwriting good; nothing but constant practice will enable you to write a really excellent hand. Cox's (Hughes) or Vere Foster's (Blackie). Mansford's Arithmetic, 4s. 6d. (Hughes), would suit you admirably.

12. J. W. SMITH, Radcliffe.—Marriages were first solemnized in churches in the reign of Henry III. How and where were they solemnized before?

The custom was, we believe, for the couple who wished to be united to go to the nearest priest, when, in the simplest fashion possible, in no particular place, and with a minimum of show, the celebration was effected.

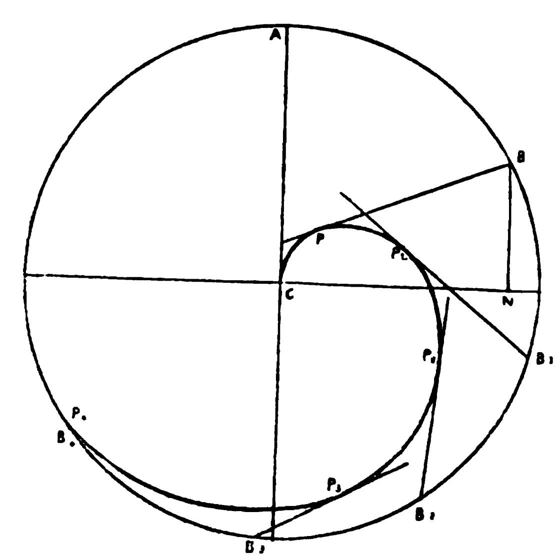
13. W. NEAL, Boston.—Taylor's *How to Compose*, price 1s. (Hughes), Dr. E. A. Abbott's book, or books, on the same subject, and many others at once occur to us as suitable.

14. DUPLEX, Middlesborough.—A ball, weighing one ton, is let fall from a height of fifteen feet, and strikes an iron plate lying on the ground. Required, the pressure on the plate.

Pressure on plate = momentum destroyed.
= mass × velocity.
$= \sqrt{2 \times 32 \times 15}$ tons $= 8\sqrt{15}$ tons.
$= 30\frac{1}{2}$ tons nearly.

15. WILLIAM SEYMOUR, South Shields.—A man at the centre of a circle 500 yards in diameter starts in pursuit of a horse running round its circumference at the rate of one mile in two minutes. The man goes at the rate of one mile in six minutes, and runs directly towards the horse in whatever direction he may be going. Required, the distance each will run before the man catches the horse, and what figure each will describe.

Simple as this problem seems, it utterly transcends all the powers of mathematical analysis to solve it completely. We cannot even get the equation to the curve in Cartesian co-ordinates, and all we can do, in fact, beyond giving a few general hints, is limited to finding the differential equation to the path. Suppose the



horse to move with uniform angular velocity ω round the circle, the horse starting from A, the man from C, and moving with uniform velocity which is e times the linear velocity of the horse. We take algebraical figures for the velocities, etc., to simplify matters, because, as we have said, we are utterly unable to reach a definite solution. Let t be the time which elapses before the horse reaches any point B, the man being simultaneously at P, and thus BP being the tangent at P. $\angle ACB = \omega C$, arc AB $= r\omega t$ $\therefore$ arc CP$= er\omega t$. Call CP s, then $\omega C = \frac{s}{er}$,

$$\angle CBN = \angle ACB = \frac{s}{er}.$$

$$\therefore CN = r \sin \frac{s}{er} \quad BN = r \cos \frac{s}{er}$$

$$\therefore \text{the co-ordinates of B are } \left(r \sin \frac{s}{er},\, r \cos \frac{s}{er}\right)$$

Now P being the current point (x, y) since the tangent at P to the locus passes through B

$$r \cos \frac{s}{er} - y = \frac{dy}{dx}\left(x - r \sin \frac{s}{er}\right)$$

Now $s = \int_0^x \sqrt{1 + p^2}\, dx$ where p has its usual meaning of $\frac{dy}{dx}$, q having, where used in future, the meaning $\frac{d^2y}{dx^2}$

$$\therefore r\left\{\cos \frac{\int_0^x \sqrt{1+p^2}\,dx}{er} + p \sin \frac{\int_0^x \sqrt{1+p^2}\,dx}{er}\right\} = y + px \quad (1)$$

This is the differential equation to the path of the horse. We must proceed to eliminate the circular functions.

Let $\frac{\int_0^x \sqrt{1+p^2}\,dx}{er} = \phi$, then $\frac{d\phi}{dx} = \frac{\sqrt{1+p^2}}{er} = f$ (say).

Then differentiating equation (1)

$$r(-f \sin \phi + q \sin \phi + pf \cos \phi) = 2p + qx.$$

Hence we have the two equations—

$$r(q - f) \sin \phi + rpf \cos \phi = 2p + xq$$
$$rp \sin \phi + r \cos \phi = y + xp$$

Now the eliminant of $\left\{\begin{array}{l} a_1 \cos \phi + b_1 \sin \phi = c_1 \\ a_2 \cos \phi + b_2 \sin \phi = c_2 \end{array}\right\}$ is by solving for $\sin \phi$ and $\cos \phi$, and substituting in the equation

$$\sin^2 \phi + \cos^2 \phi = 1, \text{ seen to be}$$

$$(a_1 b_2 - a_2 b_1)^2 = (a_1 c_2 - a_2 c_1)^2 + (b_1 c_2 - b_2 c_1)^2$$

This, substituting the co-efficients of the given equations, becomes—

$$r^2\{q - f(1 + p^2)\}^2 = \{2p + qx - pf(y + px)\}^2 + \{2p^2 - qy + f(y + px)\}^2$$

f, however, is irrational, and $= \dfrac{\sqrt{1+p^2}}{er}$. Collecting co-efficients, it is obvious that we have

$$r^2q^2-(2p+qx)^2-(2p^2-qy)^2+f^2\{r^2(1+p^2)-p^2(y+px)^2 - (y+px)^2\}$$
$$= 2f\{r^2q(1+p^2)-p(2p+qx)(y+px) + (2p^2-qy)(y+px)\}$$

Squaring both sides, and substituting for p, q, f, their values and simplifying, we have finally—

$$\left[r^2\left(\frac{d^2y}{dx^2}\right)^2-\left(2\frac{dy}{dx}+x\frac{d^2y}{dx^2}\right)^2-\left\{2\left(\frac{dy}{dx}\right)^2-y\frac{d^2y}{dx^2}\right\}^2 + \frac{1}{e^2r^2}\left\{1+\left(\frac{dy}{dx}\right)^2\right\}^2\left\{r^2-\left(y+x\frac{dy}{dx}\right)^2\right\}\right]^2=$$
$$\frac{4}{e^2r^2}\left\{1+\left(\frac{dy}{dx}\right)^2\right\}\left[r^2\frac{d^2y}{dx^2}\left\{1+\left(\frac{dy}{dx}\right)^2\right\}-\frac{d^2y}{dx^2}\left(y+x\frac{dy}{dx}\right)^2\right]$$

This is a differential equation of the second *order* and twelfth *degree*, and consequently will in general involve twelve ambiguities and two undetermined constants.

The ambiguities, however, may be disposed of, because the limits of integration are in all cases x and 0.

It is humiliating, however, to have to confess that here the powers of mathematical analysis can carry us no farther. There is no process yet known by which such an equation as we have obtained can generally be solved. Throughout the whole range of this subject of differential equations, indeed, we are on the boundaries of our knowledge. The merest novice could puzzle the greatest expert. In what way the exploration is to be commenced, or whether it has any chance of ultimately, and in reasonable time, succeeding, is more than can be said. Even algebraical equations still remain a puzzle; quadratics, cubics, and quartics have long been mastered, but to find an algebraical solution of the general equation of the fifth and higher orders has, as yet, baffled the acutest mathematicians. The case is still worse with differential equations. No one has yet mastered the analogues to quadratics even, except in very special and limited cases, much less those of higher orders.

Thus, then, it is completely evident that we must admit ourselves beaten by the horse; nevertheless, as the result of geometry or obvious analysis, we may state the following facts:—

(1) If the relative velocities of horse and man be such that the man catch the horse before the first round, the curve will be as in the fig., where P_1, B_1; P_2, B_2; P_3, B_3; P_4, B_4 represent successive simultaneous positions of man and horse respectively, P_4 and B_4 being coincident.

(2) If the velocities of man and horse be such that the man do not catch the horse before it have run once round, he will *never* catch it; in general his path will always be approaching indefinitely nearer to an asymptotic circle of radius er.

Of course when $e=0$, *i.e.*, velocity of horse is infinite, the man never leaves the centre.

The whole subject of curves of pursuit, as they are called, is at present in a very imperfect state, owing chiefly to the imperfection of our tools. If we suppose the circle to be of infinite radius, and the man to have run so far, having started from the centre which is at infinity, as to be now a finite distance from the horse, the problem reduces itself to one that is treated in Tait and Steele's *Dynamics of a Particle*. The question is there put under the form of the curve which a dog takes in following his master. It is shown that if e be the ratio of velocities of man and dog, the Cartesian equation is—

$$2\left(x+\frac{ae}{e^2-1}\right)=\frac{y^{e+1}}{a^e(e+1)}+\frac{a^e}{y^{e-1}(e-1)}$$

if e is not equal to 1,

$$\text{but } 2\left(x+\frac{a}{4}\right)=\frac{y^2}{2a}-a\log\frac{y}{a} \text{ if } e=1$$

the latter curve having $y=0$ as an asymptote.

One is almost tempted to doubt whether the dog is fully conscious of the niceties of his path.

This particular case is the only one which has yet been satisfactorily investigated, and of course it fails to give the numerical answer to your question.

16. PAN, Hackney.—(1) No. (2) Whenever you have a doubt about the interpretation of directions in an examination, take them in the widest, and therefore safest manner. In the case you name, decidedly state the rules of concord.

17. TUTBURY, notwithstanding Mason, is perplexed about the phrases—

It weighed six pounds.
The cloth measures three yards.

There are three main theories about the words (*pounds* and *yards*), that they are remnants, namely, of

(1) An Accusative.
(2) A Genitive.
(3) A Dative.

There would certainly be five other theories if there happened to be five cases on to which to tack them. The third we may dismiss at once. If the second be the right one, we may perhaps say that the root-idea, arising in an obvious manner, is *partition*. If the first, that the root-idea is *extent* or *measurement*. Both these notions are represented in Latin, similarly, by Genitive and Accusative. If 'Tutbury' is still not satisfied, and wishes to know further why the Genitive expresses *partition*, the Accusative *extent*, we must frankly say we do not know. The ideas of partition and extent existed before the aborigines, who, finding them, decreed special inflections to represent them, which we in turn, discovering, christen Genitive and Accusative.

18. A SUBSCRIBER, Manchester.—Out of a bag of silver I take 50s. more than ·5 of whole sum which it contained; then 30s. more than ·2 of what remained; and then 20s. more than ·25 of what then remained; after this 10s. remained. What did the bag contain at first? Turn the sum upside down. 20s. + 10s. = 1 — ·25 = ·75 of second remainder, ∴ second remainder = 40s. 40s. + 30s. = ·8 of first remainder, ∴ first remainder = $\frac{175\text{s.}}{2}$ $\frac{175}{2}$ + 50s. = ·5 of whole, ∴ whole = 275s.

19. C owes B ·6 of what B owes A; B gives C 5s. to put the accounts between them all straight. What is B's debt to A?

The difference of what B owes A and C owes B = 5s.

∴ (1 − ·6) of B's debt to A = 5s.

∴ B's debt to A = $\frac{5}{2}$ × 5s. = 12s. 6d.

20. W. J. WHITE, Reading.—Divide a straight line into two parts, such that the square on the one part shall be equal to twice the square on the other part. Let AB be the given line. Draw AD perpendicular to AB, and bisect the angle DAB by AE. Bisect the angle EAB by AF. Make $\angle ABF^1$ equal to half a right angle, taking F^1 on the same side of AB as F was, and let AF and BF^1 intersect in F. Make $\angle AF^1C$ equal to the angle FAC, and let FC meet AB in C. Then C shall divide the line as required for $CB^2 = CF^2 + FB^2 = 2CF^2 = 2CA^2$.

21. L. N. M., Corrie.—If the increase in the number of male and female criminals be 1·8 per cent., while the decrease in the number of males alone is 4·6 per cent., and the increase in the number of females is 9·8, compare the number of male and female criminals. f standing for the number of female criminals, m for the number of males,

$$(1{\cdot}8)(m+f)=(9{\cdot}8)f-(4{\cdot}6)m;$$
$$\therefore m(1{\cdot}8+4{\cdot}6)=f(9{\cdot}8-1{\cdot}8);$$
$$\therefore m(6{\cdot}4)=f(8);$$
$$\therefore m:f::5:4.$$

22. J. F. M., Bryn Amman.—If a snail creep 2 feet 7 inches up a pole during 12 hours in the night, and slip down 16 inches during 12 hours in the day, how many hours will he be getting to the top of a pole 35 feet high? In 26 days he will have climbed $26\{2\frac{7}{12}-1\frac{1}{3}\}$ feet $= 26\times\frac{5}{4}$ feet $= 32\frac{1}{2}$ feet, ∴ there are 2 feet 6 inches left. These he will do in $\frac{30}{31}\times 12$ hours. since he does 31 inches in 12 hours, ∴ altogether he takes $635\frac{19}{31}$ hours. Your difficulty has been the same as that of the sophist to whom the question was first proposed, reasoning thus: Net result of his climbing is $1\frac{1}{4}$ feet *per diem*, he has 35 feet to do, ∴ he takes 28 days.

23. C. P. EDWARDS, Glasgow.—Use the following books:—*Latin Prose through English Idiom*, by Dr. E. A. Abbott (Seeley), 2s. 6d.; Hamblin Smith's *Latin Composition* (Rivington), 3s. 6d.; Arnold's *Latin Prose Composition*, Part 1, 6s. 6d.; Millington's *Selections for Latin Prose* (Longman), 8s. 6d. If these are successfully worked off, you may proceed to Wilkins' *Selections for Latin Prose*. Get the books in the order named; but Arnold's is the best if you only wish one.

24. JAMES CARPENTER.—What are the factors of

(1) x^3+644^3
(2) $729x^3+512y^3$

The factors of a^3+b^3 are $a+b$, $a+\omega b$, $a+\omega^2 b$, where $\omega^3=1$, *i.e.* $\omega=\dfrac{-1\pm\sqrt{-3}}{2}$. In the remaining part of the sum we will

always suppose that $\left\{\begin{array}{l}\omega=\dfrac{-1+\sqrt{-3}}{2}\\[2ex] \omega^2=\dfrac{-1^2-\sqrt{-3}}{2}\end{array}\right\}$. If the minus value is given to the radical, the order, but not the product, of the factors is changed.

Thus $x^3+64y^3=x^3+(4y^3=(x+4y)(x+4\omega y)(x+4\omega^2y)$
$729x^3+512y^3=(9x)^3+(6y)^3x=(9x+6y)(9x+6\omega y)(9x+6\omega^2y)$.

If real factors only are wanted, they are respectively

$$(x+4y)(x^2-4xy+16y^2) \text{ and } (9x+6y)(81x^2-54xy+36y^2).$$

25. J. S., Dumfries.—It would seem to us that you already know amply enough to get you creditably through the examination to which you refer. If you desire a further enlargement of your views on the subjects, the following are rather more advanced books:—Todhunter's *Euclid* (Macmillan), 3s. 6d. Read to the end of Book VI., so as to enable you to grasp the Trigonometry more perfectly, and work as many of his 600 exercises as you can. Todhunter's *Algebra* (Macmillan), 7s. 6d. You can omit most of the chapters which do not bear on your work. Todhunter's *Trigonometry* (Macmillan), 5s. Same remark applies to this. Sonnenschein and Nesbitt's *Arithmetic* (Sonnenschein), 5s. 6d. This will be of particular help if you are at all shaky in elementary notions of number, quantity, etc. We have not space to give you any general directions for work, but must refer you to the article on 'How to Write an Examination Paper,' in Number 1, PRACTICAL TEACHER.

26. J. GREEN, Stockport.—The average of ten results was $17\frac{1}{2}$; that of the first three was $16\frac{1}{4}$, and of the next four $16\frac{1}{2}$; the eighth was 3 less than the ninth, and 4 less than the tenth. What was the last result?

Let x be the last result, $x-4$ is the eighth result,
$x-1$ is the ninth;
$\therefore$ sum of last three $=x+(x-4)+(x-1)=8x-5$,
also sum of first three = three times their average $=3\times16\frac{1}{4}4=8\frac{3}{4}$,
" next four = four times their average $=4\times16\frac{1}{2}=66$,
and sum of all the ten = ten times their average $=175$;
$\therefore 175=66+48\frac{3}{4}+3x-5=3x+109\frac{3}{4}$;
$\therefore 3x=65\frac{1}{4},\quad x=21\frac{3}{4}$.

27. R. GIBBONS, Stockport.—The sum of £1001 was laid out in the 3 per cents. at $89\frac{3}{8}$, and a whole year's dividend having been received upon it, it was sold out, the whole increase of capital being 72 guineas. Find at what price it was sold out.

£$89\frac{3}{8}$ produces an income of £3,

£1 " " £$\frac{24}{715}$,

£1001 " " £$\frac{24}{\underset{5}{\cancel{715}}}\times\frac{\overset{7}{\cancel{1001}}}{1}=$ £$\frac{168}{5}=$ £33 12s.,

also his capital altogether is increased by £75 12s.;

$\therefore$ he received from selling out his stock £42 + £1001 = £1043;

$\therefore$ the selling price is $\frac{1043}{1001}\times 89\frac{3}{8}=\frac{\overset{149}{\cancel{1043}}\times\overset{5}{\cancel{715}}}{8\times\underset{7}{\cancel{1001}}}=\frac{745}{8}=93\frac{1}{8}$.

28. J. H., Cranbrook.—(1) We do not advise you to try to learn Mensuration without some knowledge, however slight, of Algebra. The very problems that occur in practice are the ones that need a little Algebra; take, for example, the one that we answered last month about a hole bored through a sphere. Before you commence Mensuration we strongly advise you to know (i.) the rudiments of Algebra; (ii.) Euclid, Books I.–VI.; then you may enter on the study of Todhunter's *Mensuration* (Macmillan), price 3s. 6d. Even without the knowledge we name, we think Todhunter would meet your purpose. (2) Hamblin Smith's *Algebra*, price 3s., key 9s., would suit you best. The publisher is Rivington.

29. C. WHATMOUGH, Stockport.—If 20 men can dig a trench 37 yards long, 4 feet wide, and 9 feet deep, in 18 days of 9 hours each, how many days of 10 hours each will 50 men require to dig a trench 100 yards long, 8 feet broad, and 18 feet deep, the labour increasing by $\frac{1}{3}$ on the average for every 9 feet of depth? This sum is worded in such an indefinite way that we cannot certainly determine what it means. We work it under the two different interpretations. (1) The ordinary arithmetical sense—the work increasing by $\frac{1}{3}$ at the end of 9 feet; hence, as the depth is 18 feet, the total work done is that due to a depth of $(1+\frac{1}{3})\times18=24$ feet.

20 men dig $111\times4\times9$ c. feet in 162 hours.

1 man " 1 c. foot in $\frac{162\times20}{111\times4\times9}$ hours.

50 men " $300\times8\times24$ c. feet in $\frac{\overset{18}{\cancel{162}}\times\overset{5}{\cancel{20}}\times\overset{6}{\cancel{300}}\times8\times\overset{8}{\cancel{24}}}{\underset{37}{\cancel{111}}\times\cancel{4}\times\cancel{9}\times\cancel{50}}$ hours.

Hence they will dig it in $\frac{18\times\cancel{5}\times\overset{3}{\cancel{6}}\times64}{37\times\underset{2}{\cancel{10}}}$ days $=\frac{54\times64}{37}$

$=93\frac{15}{37}$ days = 93 days 4 hours nearly, inasmuch as each day consists of 9 hours nearly. (2) Suppose the labour to increase uniformly as the depth increases, instead of at one moment. In this case it may be proved in the same way as $s=\frac{1}{2}ft^2$ is established in Dynamics that the total increase of work is just double what it was, so that the labour is equivalent to that due to a depth of $(1+\frac{2}{3})\times18$ feet $=\frac{5}{3}\times18$ feet; $\therefore$ the time employed is $\frac{5}{4}$ of what it was, *i.e.* 116 days $7\frac{1}{2}$ hours nearly.

30. NIHIL, Whitchurch.—Square £19 19s. $11\frac{3}{4}$d. in a shorter way than by Vulgar Fractions or Practice. Though we must confess ignorance as to what a square £ sterling is, it is obvious what our correspondent means.

£19 19s. $11\frac{3}{4}$d. = £20 − $\frac{1}{4}$d. $=20-\frac{1}{960}$

$$\left(20-\frac{1}{960}\right)^2=20^2-2\cdot20.\ \frac{1}{960}+\frac{1}{960^2}$$
(since $(a-b)^2=a^2-2ab+b^2$)

$=400-\frac{1}{24}+\frac{1}{960^2}$

$=$ £$400-\frac{5}{6}$ shillings $+\frac{1}{960}$ farth.

$=$ £400 − 10d. $+\frac{1}{960}$ farth.

$=$ £399 19s. 2d. $+\frac{1}{960}$ farth.

We hope we have rightly grasped your idea.

31. HEREWARD, Stone.—The phrase 'fifteenths' refers to a property-tax of one-fifteenth of the net value, which was imposed in the reign of James I.

32. A. LANHAM, Walkden.—See *Query Column*, No. 10, in PRACTICAL TEACHER, No. IV., for answer to your question.

Engagements for July.

July 1. Council of Teachers' Orphanage and Orphan Fund.
2. Executive Meeting and Organisation Committee of N.U.E.T.
4. Royal Asiatic Society.
Education Society, 'Rewards and Punishments.' Discussion.
5. General Board of Management of Teachers' Provident Society.
6. Parliamentary and Law Committee of N.U.E.T.
Entomological Society.
7. Zoological Society, 'The Limbs of Birds.' Prof. W. K. Parker, F.R.S.
11. Education Society, 'Object Lesson.' T. M. Williams, B.A.
13. Finance Committee of N.U.E.T.
14. Zoological Society, 'Birds Ancient and Modern.' W. A. Forbes, Esq.
15. Executive Meeting of N.U.E.T.
16. Organisation Committee of N.U.E.T.
18. Central Committee of Teachers' Benevolent Fund.
20. Parliamentary and Law Committee of N.U.E.T.
21. Royal Historical Society. Papers by the Rev. E. King and Dr. Zerffi.
Zoological Society, 'Zoological Gardens.' P. L. Sclater, Esq., F.R.S.
25. Finance Committee, N.U.E.T.
28. Zoological Society, 'Chameleons.' Prof. Mivart, F.R.S.

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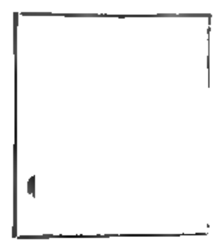

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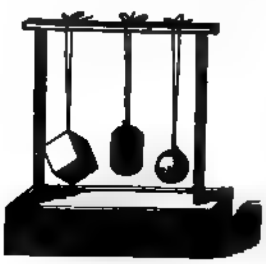

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Health at School.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),

President of the Council of the British Medical Association.

No. V.—CONSTRUCTION OF THE BUILDINGS.

THIS part of the subject divides itself into several heads connected with the nature of the foundation, the condition of the walls, the character of the floor, the capacity of the rooms, method of lighting, etc. Intimately associated with it is also the best course for ventilation and warming, whilst the adjuncts which are required in a school, such as cloak and hat rooms and washing-places, must not be lost sight of. We have shown that the position of the bath and washing-places generally shall be such as may enable the waste water to be used for the purpose of flushing the sewers. It will be best for the urinals and W.C.'s to be so situated as to be capable of frequent flushing, where a copious supply of water is available. These latter portions of the establishment should never be a part of the building, but placed in anexes rather than as parts of the fabric. It is requisite also to keep in mind the recommendations that no sewer shall, under any pretence whatever, be carried directly within or under the fabric of the building. It is also necessary that the subsoil water should not be capable of changing its level very easily, for reasons already pointed out. The walls of the school-house should be protected by a damp course, such as slate or other impervious material, imbedded in asphalte or cement, so as to effectually prevent the rise of water in the walls, whenever there is any chance of the invasion from below or without: a layer of sheet-lead is sometimes inserted. It is always best to keep a fair space on the outside of the building well paved or asphalted, so as to prevent any soakage from rain. The floor of the schoolroom should always have a basement beneath it, which must be thoroughly ventilated. The basement should have an asphalted or concreted floor. This space may be used for stores, but never as a playground or living-room for any of the attendants, unless it is above the level of the surrounding soil. It may be useful also for warming and ventilation purposes. The floor of the school should be constructed of narrow planks of close-grained wood, such as pitch-pine or oak, with dovetailed or matched joints, so that none of those interstices (too often seen in floors) can exist, in which, when they are present, all manner of abominations may be retained.

The floor should be well oiled or soaked with paraffin. I do not think it right to use asphalte or concrete, or to have stone or brick floors. Wood being a bad heat conductor, is warmer, more equal in its temperature, and if well laid with hard wood the floor is easily kept clean. The walls should be perfectly impervious, so as not to allow of the absorption of the foul air which naturally attaches to a crowded assembly. If ordinary brick or limestone is alone available, the walls should be cemented in every part with hard cement. In those parts of the country in which impervious bricks, polished or glazed, or ironstone can be procured, I prefer to leave the walls uncovered; they may be finished if laid in hard cement without plaster or paint or paper of any kind: this diminishes the annual coast for repairs and maintenance, and looks very well, especially if the walls are picked out with bricks of different colours. There is an immediate disadvantage in this kind of wall because it requires much greater care in ventilation than a pervious wall does, and the bad consequences of defective ventilation show themselves more immediately; but if more immediate they are also more temporary, for efficient ventilation at once gets rid of the *materies morbi.* Not so in the case of buildings having porous walls; for a time the lime contained in their very composition is a safety from the consequence of overcrowding. But after a time this safeguard is overtaken and the lime does not act as such. Then the walls gradually saturate with animal matter, and in the end the building itself becomes a very focus of disease. Impervious walls shut out much of that continuous and imperceptible ventilation which makes old brick and plaster buildings healthier than more modern and less pervious places when these latter are badly ventilated, but there is a limit, and there is danger that the porosity of the walls may be overtaken. This kind of porosity is shown in dirty so-called smoke-dried rooms. The rafters are mapped out on the ceiling by cleaner lines than in the spaces between the rafters. These cleaner lines arise from the fact that ventilation is impeded on the line of the rafter, air passing through the plaster is filtered from its smoke and other organic matters which remain attached to the surface of the plaster; fortunately, the

carbon is a disinfectant and destroys the ammoniacal compounds which are to be found in the air of this class of rooms, otherwise they would be pest houses, and spread infectious diseases in a most alarming manner. Whenever a ceiling shows this condition of things, it gives evidence of impure air: there is a necessity for fresh liming; but more than that, there is a necessity for a better ventilation, so that fresh air may get in and foul air get out in a more satisfactory manner than through pervious walls of mortar.

Cornices, string courses, and projections of every kind upon which dust can gather should be ruthlessly prohibited on the walls, or in any part of the room. The tops of doors and windows should be levelled off, and indeed all kinds of irregularities taken away, even raised thresholds should be avoided: everything which will interfere with a clean sweep is wrong. Granite and other stone of the Cambrian series are not good stones for building schoolhouses; brick is far more preferable when properly finished in the interior. I am rather an admirer of Mr. Lascelles' principle for house construction. His buildings are fire-proof and damp-proof; they are impervious to air and water, and artistic in appearance, whilst they provide a market for that which is scarcely marketable, viz., the refuse of ash-pits. The impervious slabs which he manufactures make the best possible materials for school-walls. I have reason to believe that the buildings created by his method will be found to be less liable to some forms of infectious diseases, such as scarlatina and diphtheria, than any other. He has built a considerable number of cottages in this neighbourhood; they are very healthy buildings. The material itself is most excellent and durable, as floors for passages and places not intended as places for living in; but I prefer wood for the floors of schoolrooms and living-rooms, even in preference to Mr. Lascelles' slabs, excellent as they are for wall and ceiling purposes. The walls being well-finished brickwork picked out in different colours, or cemented, require neither paint nor paper. The wood-work where visible should be varnished or stained, not painted, and a well-matchboarded ceiling with stained wood looks as well as anything. If the ceiling is not wooden it should be capable of being limed. It should be well provided with openings for free ventilation, as will be explained when that subject is considered. The method of lighting is one to be considered, and construction cannot be finished in a proper manner if the course to be pursued is taken no account of. The windows should be capable of opening either as sashes let down from the top and raised from the bottom—this is the best way, as it creates circulation—or they may open as louvres sideways. The top of the window-sash must be very near to the top of the ceiling, otherwise a portion is left in which the air of the room may be comparatively stagnant. The windows should be so placed that the light of the sun may shine into every part of the room during some part of the year.

VENTILATION.

One of the most important subjects connected with health at school is that which deals with overcrowding. '*Too many children in the school*,' is the impression which is upon the mind of every lover of fresh air as soon as he sets foot in a school the pupils of which have been assembled for an hour or two, and have remained in the room. I seldom go into any school in the middle of working-time, especially in cold weather, without being struck with this fact, that the air is too impure for perfect health. The impurity arises from overcrowding connected with a want of ventilation. These two subjects are mixed up very much together; one school with a hundred boys or girls in it may have a much purer air than another of the same size with only fifty, because in the one case the products of respiration are rapidly removed, and in the other in a great measure retained. The question of floor space is an important one, but not nearly so important as that of ventilation. If the air could be fairly and properly renewed, children might be more crowded together, even more than the Privy Council allows in elementary schools, which is eighty cubic feet for each child in average attendance, or fifteen square feet of floor space; but as schools are generally conducted this is really much below the requirements of healthy school-life. Cubic as well as floor space is a delusion in various ways: one room ten feet high will ventilate better than another fifteen or even twenty, because in the one case the windows are carried up to the ceiling, and in the other there is seven or eight feet of wall between the top of the window and the ceiling itself. Cubic space is all but useless as a guide to the managers. The age of the children will be a factor in the case, though not so great as is often represented; for a child of six or seven requires nearly as much fresh air as one double that age. There are very few schools in which ventilation is so well provided that the regulation area can be kept without sometimes being the cause of mischief, at the same time the great increase of expense which arises from any large increase to the floor space is an argument in favour of efficient ventilation.

This is generally said to be provided, and in theory it may be, but in practice, if it is properly weighed in the balance it is found wanting when most necessary.

It will be only right that I should give the reasons for ventilation and show that the floor space can only be kept down by providing for the continuous removal of the effete products which arise from the simple act of living. A pure air consists, on the average, of oxygen, 20·9; nitrogen, 78·95; carbon anydride, ·04; some aqueous vapour with traces of nitric acid and ammonia and other hydrogen gases. The CO_2 is the principal impurity which is most easily capable of detection. In crowded rooms it will by its increase be a mark of the amount of albuminoid ammonia which will also be found; this is exhaled with the CO_2 from the pulmonary membrane and skin. If the CO_2 is increased, there will be a corresponding decrease of oxygen. If the CO_2, which is naturally 400 parts in a million, be increased to 600, the oxygen will be decreased in a corresponding ratio. The air of great cities like London does not vary much in this matter, even if compared with the purest country-places, and Dr. Angus Smith tells us that 'Nature never seems to offer us air with even the loss of 1,000 parts of oxygen in a million, comparing healthy places with unhealthy.'

The difference is the same as for CO_2, but in the opposite direction, viz., about 200, and this, says Dr. Angus Smith, indicates a similar difference of vital principle in the air. The object of ventilation is to carry away the used-up air with its impurities of carbon anydride, albuminoid ammonia, minute particles of epithelium from the skin and other dis-

agreeable sources, with aqueous vapour, and bring in the requisite quantity of oxygen. It is almost impossible to get in a supply of ozone, except in those places which are not exposed at once to the influence of great cities; its absence is a proof of adulteration, but we are at present too ignorant of the influence of ozone to write about it in a dogmatic manner. It is not the presence or absence of a minute fraction of CO_2 which makes all the difference between a pure or an impure air, but it is the concomitants of that fraction. It is possible that the power of oxygen to pervade the tissues, to enter the circulation by endosmosis, and to give out CO_2 by exosmosis, is interfered with by the smallest possible alteration in the quantities of the atmospheric constituents, whilst the materials exhaled are undoubtedly poisons to the human frame; but whilst the increase or decrease of the CO_2 is of no absolute consequence, its presence, when that presence is caused by the respiration of flesh-eating animals, is a mark of the presence of other more deleterious matter which is not so easy of detection, but which is removed with the CO_2. The amount of CO_2 must be raised 250 times to reach the proportion of one per cent. An atmosphere which contains one per cent. of CO_2 gives headache; a candle is put out when placed in an air containing two and a half per cent., and four per cent. would be fatal to human beings. The quantity of CO_2 exhaled by an adult in the course of an hour is about 0·6 cubic feet: this quantity is increased by active work, and is influenced by diet, by age, weight, and sex. Children exhale more than adults, weight for weight, and girls more than boys; it is probable that we may assess their adulterating power at 0·40 cubic feet per hour for each individual. The problem before us is how to prevent the quantity of CO_2 rising from ·04 to something above ·06, as this will be the best means for diminishing the organic matters and watery vapour which also accompanies the excess of CO_2.

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Practical Lessons on Insect Life.

No. IV.—THE COLEOPTERA, OR BEETLES.

BY THEODORE WOOD, M.E.S.,

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PART I.

BESIDES their primary division into Orders, insects are further subdivided into classes of lesser importance, which are severally known as groups, or divisions, families, and genera. These terms I will now endeavour to explain.

A group comprehends such insects in any one order as agree in some essential point of structure, such as the formation of the mouth, or the antennæ, although their general form and habits may be widely dissimilar. Thus the members of the *Clavicornia*, or 'club-horned' insects, one of the chief divisions of the coleoptera, are included in a single group on account of the structure of their antennæ, which are expanded into a rounded club, or knob, at the tip. Yet, in other points, they vary to a very great extent, and, were it not for this distinguishing characteristic, would never be recognised as belonging to the same group of insects.

Families may be described as divisions of smaller size, many of them being often included in a group. They are composed of insects agreeing in their chief characteristics, and generally exhibiting less variety of form than is the case in a group.

A *genus* is a smaller family, and sometimes consists of a single insect alone, in other cases of many hundreds. In a genus, as a rule, there is comparatively little diversity of form.

As regards the nomenclature of insects, every known species possesses two scientific names, just as is the case throughout the zoological and botanical kingdoms. The first is that of the genus, which is borne alike by all the insects included in it; the second that of the individual species. Besides these, in a full description, the names of the order, group, and family would be introduced. So, we might describe the well-known Purple Ground Beetle as follows—order, *Coleoptera;* group, *Geodephaga;* family, *Carabidæ;* genus, *Carabus;* species, *violaceus;* while we should ordinarily speak of it merely as *Carabus violaceus.* Other members of the genus would be known as *Carabus granulatus, C. auratus,* and so on. The Red Admiral Butterfly, too, we should describe as—order, *Lepidoptera;* group, *Rhopalocera* (or Butterflies); family, *Vanessidæ;* genus, *Pyrameis;* species, *Atalanta;* speaking of it merely as *Pyrameis Atalanta.*

The *Coleoptera,* or beetles, are generally considered as being divided into twelve *groups,* each of which will be mentioned in turn.

The first, and one of the most important, is that of the *Geodephaga,* a word signifying 'earth-devourers,' *i.e.,* predacious beetles living upon the land, as opposed to those inhabiting the water.

In this group are included many most interesting insects, some of which play no inconsiderable part in maintaining the balance of Nature.

For example, who would think that many of the enormous pine forests of the Continent, whence we obtain so large a share of our timber, owe their very existence to the labours of a single Geodephagous beetle? Yet, such is the fact, and, were it not for this insect, which is known as *Calosoma sycophanta,* hardly a pine-tree would now be left standing.

The beetle is a most gorgeous object, reminding one of tropical insects in the brilliancy of its colours. The thorax is of a deep violet black, with the borders brighter, as is the case in the Purple Ground Beetle, while the elytra, or wing-cases, are of a brilliant gold-green shot with purple, the hues seeming to change with every movement of the insect.

In our own country this beetle is extremely rare, and the few specimens which have been met with have probably been accidentally introduced from abroad. Upon the Continent, however, it is plentiful enough, fortunately for mankind.

Its services, both as a larva and a perfect insect, consist in devouring the destructive caterpillars of various moths, more especially those of the Processionary *(Cnethocampa processionea)* and the Gipsy *(Liparis dispar).* But more destructive even than these, the grub of the Pine Saw-fly is more especially attacked by the *Calosoma,* which keeps down its numbers to a most wonderful extent. But for this, a single year would witness the destruction of large tracts of forest, for the pine-trees, once stripped of their leaves, cannot, like other trees, throw out fresh foliage, but speedily die.

So useful is the *Calosoma,* that it has even been introduced into infested districts where it did not previously occur, and with the very best results.

The well-known Tiger Beetles *(Cicindelidæ)* are included among the *Geodephaga*, and form the first family of the group. They may be seen on any sunny day throughout the summer, and are especially common on sandy banks, heaths, etc., dashing about in the hot sun like living gems, and taking to flight with the ease and rapidity of a blue-bottle. Both in the larval and perfect states these beetles, four species of which inhabit England, are extremely voracious, preying chiefly upon the smaller insects.

There is an extraordinary beetle in this group which has the singular property of possessing a mimic artillery with which to repel its foes. This is the Bombardier *(Brachinus crepitans)*, which secretes a highly volatile fluid, a small quantity of which it can expel at will. When pursued by any of its numerous foes, the beetle ejects a small portion of this fluid, which passes into vapour as soon as it comes in contact with the air, causing at the same time a slight explosion, and effectually alarming its enemy. This discharge it can repeat twenty or thirty times in succession, the cloud of blue smoke bearing a remarkable resemblance to the fire of small artillery.

Should any of this volatile fluid come into contact with the human skin it causes a slight burning sensation, and leaves a perceptible stain behind it. The beetle is chiefly found upon the banks of rivers, where fifteen or twenty specimens may sometimes be found beneath a single stone.

The greater number of the beetles of this group seek their prey only by night, retiring during the day to some place of concealment where they may be sheltered from their numerous enemies. They may often be found hiding beneath stones, dead leaves, etc., and in similar places.

The next division is that of the *Hydradephaga*, or Water-devourers—*i.e.*, predacious beetles which live chiefly beneath the surface of the water. Their structure is worthy of a detailed examination.

First, as regards their swimming capabilities. All these beetles swim by means of the hind-legs, which are very long, flattened, and closely fringed with long stiff bristles. These legs perform the functions of oars, and are formed in such a manner that, as they are brought forward for a second stroke, they turn sideways and present their edge to the water, thus cleaving through it, and offering no resistance. In fact, they are 'feathered,' just as are the oars of a boat,

only in the case of the insect the operation is entirely mechanical.

Although of the greatest service in the water, enabling their owner to travel at a considerable speed, these legs are of very little use upon dry land, and, indeed, seem rather to incommode the insect than otherwise. It proceeds by the most awkward and ungraceful waddle that can possibly be imagined, feeling, no doubt, much as does a skater when his rapid and easy evolutions are suddenly stopped by the breaking of a skate, and he is obliged to walk back upon the ice.

These water-beetles are possessed of broad and powerful wings, which enable them to pass from pond to pond at will. They usually perform their aerial journeys by night, and are accustomed, when they wish to return to their native element, to hover over a pond or stream, and, suddenly closing their wings, allow themselves to drop into the water, often from a considerable height. Sometimes mistaking the glass roof of a greenhouse for a pond, they fall upon the panes with a considerable shock, doubtless much to their astonishment.

Upon examining one of these insects it will be seen that, when the wings are packed away, a considerable space is left between the elytra and the body, the object of which may not at first be apparent. Its real use will shortly be seen.

Although the *Hydradephaga* pass a considerable portion of their existence beneath the water, they are not provided with gills, as are the fish, but are forced to breathe atmospheric air, just as are all other insects. For the purpose of renewing their supply, these insects rise to the surface of the water every few minutes.

As, however, a single respiration would suffice for so short a time that the insects would be able to spend a few seconds only beneath the water, they are provided with the means of carrying down a supply of air with them, the space between the elytra and the body serving as a reservoir. Into this, the spiracles, or breathing holes open, and a water-beetle can thus remain submerged for a considerable space of time.

When the supply of air needs renewal, the insect floats head downwards at the surface of the water, the tips of the elytra just projecting, and the long hind-legs being spread out on either side like oars. The exhausted air is then expelled with a curious popping sound, and a fresh supply taken in. On a fine day, the water insects may be seen floating in numbers on the surface of any pond, the least footstep, however, being sufficient to alarm them and cause them to retreat to the depths below.

The shape of these beetles is admirably adapted to their subaquatic life, the form bearing a close resemblance to that of the fish, while the smooth and polished surface of the body affords but little resistance to the water.

In some of the beetles of this class, and notably in the Great Water-beetle (*Dyticus marginalis*), the tarsi of the front legs of the male are modified in a very peculiar manner, being dilated into a broad pad. Upon examination with a magnifying-glass, this pad is seen to be furnished with a number of suckers, some thirty or forty in all, of various sizes, some of which are set upon stalks, while others proceed from the pad itself. As the air can be exhausted from beneath each of these suckers, the clinging power of the insect is very great, it being able to ascend the perpendicular sides of a glass jar without any apparent trouble. This structure is found in the male alone, the tarsi of the female being perfectly simple.

The sexes of this insect can be easily distinguished by a single glance at the elytra, which in the female are deeply grooved for about two-thirds of their length, those of her partner being smooth. The insect is plentiful in ponds throughout the kingdom. A very similar insect is the Lesser Water-beetle (*Acilius sulcatus*).

The name of this beetle is a singularly appropriate one, the word *Dyticus*, from the Greek, signifying a diver, and being applied to the insect on account of its swimming capabilities, and the term *marginalis* referring to the yellow border of the thorax and elytra. Several species of the genus inhabit England, of which the above-named is by far the most abundant.

The larvæ of the various water-beetles are fully as predacious as the perfect insects. They are long grub-like creatures, provided with six legs, and an enormous pair of horny jaws, to aid in the capture and detention of the prey. These jaws are perforated throughout their length, somewhat after the manner of the poison-fangs of a serpent, and through these channels the juices of the prey are sucked into the mouth.

These larvæ proceed in the water in a curious sinuous manner, approaching their prey from beneath, and seizing it before their presence is detected.

The change to the pupal condition does not take place in the water, the full-grown larva leaving the pond, climbing the bank, and burying itself in the damp mud, forming for itself a round chamber or cocoon therein.

Then there are the curious little Whirligigs, or Whirlwigs (*Gyrinus natator*), which may be seen dashing about in numbers on the surface of any pond, their polished black bodies gleaming in the sunlight. The legs are formed in a very curious manner, the second and third pairs being so short as to be scarcely visible.

It must not be thought that all the beetles inhabiting the water are necessarily *Hydradephaga*, for such is not the case. A large number are included in the *Palpicornia*, or *Hydrophilidæ*, which are, as a rule, not predacious, or only so in a very slight degree. The legs are formed more for crawling than swimming, the insects spending their existence among the weeds and mud of the ponds instead of leading the active life of the true water-beetles. All these beetles may be known by the palpi, which are as long as, or even longer than the antennæ, which never possess more than nine joints.

One of the best known, although not the most abundant of these, is the Black Water-beetle (*Hydrophilus piceus*), which, with the exception of the Stag Beetle, is the largest of our British *Coleoptera*, averaging about an inch and two-thirds in total length. This beetle will be seen represented in all its stages in the illustration on the opposite page.

The insect is remarkable for the manner in which the eggs are laid, a silken cocoon being formed by the female, and fastened to the stem of some water-plant. Within this cocoon the eggs are deposited, being thus sheltered from harm until the young larvæ emerge, an event which takes place in about five or six weeks.

The *Palpicornia* are not all frequenters of the water, many of them, such as the various Cercyons, depending for existence upon the droppings of animals, in which they spend the greater portion of their life.

Rubbish heaps, hot-beds, etc., mostly swarm with them, too, looking like small red-and-black beads when their habitation is disturbed.

(To be continued.)

Anecdotal Natural History.

No. VI.—THE CAT TRIBE.

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PART II.

NEXT in order comes the Tiger, which is spread over a considerable part of Asia. The animal which is popularly called the "tiger" by African hunters is only a large leopard, and the "tiger" of American hunters is the jaguar. It is by no means equally distributed, some parts of the country being absolutely infested by the animals, while in others they are seldom or never seen.

The tiger is fully equal both in size and strength to the lion, and certainly surpasses that animal in the ease and grace of its movements. Its colour is a bright, tawny yellow, with a number of dark brownish-black stripes, some of which are double, running round the body at right angles to the limbs. On the lower parts of the body the fur becomes nearly white, and the dark stripes melt almost imperceptibly into the general ground colour.

Occasionally a tiger is found whose fur is of a uniform greyish-white hue, the stripes being scarcely visible. This is usually known by the name of White Tiger, but is merely a variety of the common species.

It seems strange that so brightly-coloured an animal as is the Tiger should be so extremely inconspicuous among the underwood of its native jungles. Such, however, is the case, and a tiger at the distance of ten or fifteen yards would be perfectly invisible except to the most practised eye. For the dark stripes harmonise so perfectly with the dark shadows between the upright blades of the long grass, and the tawny yellow fur so strongly resembles the bright hues of the surrounding foliage, that, until it moved, even the most experienced hunter would probably be unaware of the presence of the animal.

Like the lion, the tiger seldom undertakes more active exertion when in pursuit of prey than is absolutely necessary for the attainment of his object. He seldom or never attempts open chase, but prefers to stalk his quarry, sometimes for miles, gradually creeping closer and closer, until he is able to effect his purpose by means of a single bound.

In the same way the dreaded "man-eaters" will follow human beings, generally devoting their attention to women and children, who are not likely to carry weapons.

The mortality from these animals is very great, for a tiger, when once it has tasted human blood, ever after thirsts for it, just as is the case with the lion. In some districts, even, a victim is carried off almost daily, the mingled apathy and superstition of the natives allowing the animal to carry on his depredations with impunity.

The spots most infested by tigers are those localities where the road passes through a small copse, or patch of jungle, and where water is in the immediate neighbourhood. Where water is scarce, in fact, the tiger is seldom found, as he requires to quench his thirst after every meal.

In such a retreat he lies in wait, always upon the opposite side of the road to that on which his lair is situated, until some unfortunate animal, or human being, happens to pass by. With a tremendous spring he bounds upon his victim, dashes him to the ground, and drags his body across into his lair without being obliged to turn round.

Should he happen to miss his aim, as does sometimes happen, he seldom or never repeats his attack, but seems bewildered, and mostly slinks away among the bushes. Should a number of people be together, he always selects the last of them, so that in tiger-hunting the post of honour is, as in a retreat, in the rear.

The natives divide tigers into three kinds, namely, the Hunting tigers, the Cattle-eaters, and the Man-eaters.

The first are the younger animals, which are strong and active enough to hunt prey for themselves. The natives do not try to destroy these animals, and find them rather beneficial than otherwise, because they keep down the antelope herds that make havoc in grain-fields.

The second are the older animals, which can no longer trust to the chase for food, but hang about villages for the purpose of pouncing upon any stray cattle that may come in their way.

No less than seven such tigers have been driven out of one cover, so that the destruction which they work can easily be imagined.

Their mode of attack is always the same. They do not knock down their prey with a blow from the paw, as is generally imagined, but seize it by the nape of the neck, and with both paws on the head, twist its neck.

A single tiger has been known to destroy annually between sixty and seventy head of cattle, none costing less than five pounds, and many being worth double the money. These cattle-eaters are curiously fastidious. When they have killed an ox, they drag it to their feeding-place, and then open and clean the body as neatly as any butcher could do, always putting the offal at some distance from the meat.

Old tigers, who cannot even destroy cattle, are tolerably sure to become man-eaters. Fortunately for the natives, European huntsmen never allow a man-eater to live. It is even necessary to destroy every cub of a man-eater, for if a tiger, no matter how young, has once tasted human flesh, it becomes at once a man-eater.

The fur of such an animal is never worth anything in a pecuniary point of view, as it is almost always mangy, bald in patches, dingy in hue, and never exhibits the rich, warm colouring of the healthy fur.

So great is the terror of the natives at the mere presence of a man-eater, that they seem quite demoralized. They never venture out at night, and even by day will only dare to move in large bodies, all being heavily armed and accompanied by the beating of drums and the shouts of men, the firing of shots, and the glare of flaming torches.

A single man-eater has been known to kill a hun-

dred human beings in a single year, and to put a stop to traffic in a triangular district measuring from thirty to forty miles on each side. Many villages were wholly deserted, and others in which the inhabitants remained, were surrounded with strong palisades.

The claws of the tiger form most terrible weapons, being sickle-shaped, and as sharp as a knife. As is the case in the lion, the claws seem to possess some poisonous influence apart from the actual wound, for, in many cases, even a slight scratch has been productive of lockjaw, followed rapidly by death. One hunter, of many years' experience, states that he has never known a patient to die from the effects of a wound caused by the tiger's claws without suffering from lockjaw previous to death.

Naturally, no pains are spared to exterminate so powerful and dangerous an animal, and traps of all kinds are constructed for his capture.

Some of these are most ingenious. A very common method of destruction is the spring bow, which is set as follows:

Two stout posts are planted in the ground by the side of the tiger's path, and to these the bow is firmly fastened, the string being parallel with the path. The bow is then stretched, and kept in that position by means of a stick, which prevents the string from approaching the wood. At the end of the stick is placed a long wedge, to which is fastened a cord, which crosses the path of the animal. The arrow, generally poisoned, is then laid in its place.

Naturally, as soon as the tiger presses the cord with his breast, the wedge falls, the stick is drawn away, and the arrow discharged into his body, where the poison very shortly proves fatal.

Should a tiger have paid a visit to a farmyard, and carried off a horse or bullock, his track is followed up until the carcase of the slaughtered animal is discovered. Knowing that the tiger will shortly return for a second meal, the farmer cuts a few gashes in the flesh and introduces a quantity of arsenic. Before very long, the tiger makes his appearance, and swallows great lumps of the poisoned food, which in a short time puts an end to his existence.

Farmers in this country are familiar with a method of catching rooks, when they attack the newly-planted grain, by twisting up a number of paper cones, placing a grain or two of corn at the bottom, and smearing the interior with bird-lime. These are placed in the furrows, with the pointed end downwards. The rook comes flapping along, sees the corn at the bottom of the cone, and immediately attempts to secure it. His head once in, however, he is unable to release it, the tenacious bird-lime fixing the cone over his head, and preventing him from seeing. After a short time he is exhausted by his struggles, and is then easily secured.

In much the same manner tigers are often captured.

A number of the broad leaves of the *prauss*-tree are secured, and thickly smeared with bird-lime. These are laid in the animal's path, the hunter concealing himself in the neighbourhood.

The tiger passes along, and treads upon one of the prepared leaves, which adheres to his foot. Not being able to remove it, he rubs his paw against his head, after the fashion of the cats, thereby transferring the sticky substance to his ears and eyes. By this time he has trodden upon more leaves, which serve to still further incommode him, and he struggles to free himself from the mysterious substance, rolling upon the ground in his efforts, until he has completely covered himself with the bird-lime. Guided by his voice and struggles, the hunters come up and despatch him without difficulty.

Sometimes a building resembling a huge mousetrap is constructed, and baited with a sheep or goat, which is placed in an inner chamber, so that it cannot be reached from the outside by the claws of the tiger; or a large bamboo cage is built, the hunter taking up his position inside, and spearing his foe through the bars as he ventures to attack.

Sometimes a large bamboo platform is erected near the haunts of the animal, on the summit of which the hunter takes up his station, firing at the creature the moment it appears. Even should the wound not prove instantaneously fatal, and the tiger attack him, he is in perfect safety, being above the reach of its claws, while the polished bamboo affords no foothold to his infuriated enemy, who is easily killed by a second shot.

When a hunter has been fortunate enough to kill a tiger, he always preserves the teeth and claws as tokens of his success, and the natives would not think of leaving the dead tiger without burning off its whiskers, as a kind of charm.

Besides these manifold traps, the tiger is also hunted in various ways, the most usual being by means of elephants. Upon these animals ride the hunters, who are seated in the 'howdah' (pronounced 'hŏodâh'), a sort of open carriage firmly fastened upon the back of the elephant. A large number of beaters are pressed into the service, who endeavour, by means of shouting, blowing horns, beating drums, letting off fireworks, etc., to drive the tiger from its concealment.

In spite of the size and strength of the animals ridden by the hunters, this sport is not without danger, the tiger often facing his pursuers, leaping upon the elephant, and even reaching the howdah.

It is only by careful training that the elephants are induced to face the infuriated beast at all. First, they are taught to familiarize themselves with a stuffed skin, and to gore it with their tusks, and trample upon it. Next, a boy is placed inside the skin, in order to counterfeit the movements of the animal, and accustom the elephant to the sight of the skin in motion. Finally, a dead tiger is shown to the animal, instead of the stuffed skin.

Yet, with every precaution, and the most careful training, even the most courageous elephant will sometimes turn and run before an angry tiger, in spite of the exertions of the 'mahout,' or driver, who rides upon the neck of the creature.

One would naturally think that so destructive an animal would be almost universally sought after and destroyed. Yet in many parts of the country the tiger is absolutely protected, being considered as a sacred animal, and treated accordingly. Many of the native chiefs, too, protect it for hunting purposes, just as the fox is preserved in our own country.

The tiger is a good swimmer, and has even been known to board vessels lying at a considerable distance from the shore, and causing the greatest consternation among the crew.

The young of the tiger are two or three in number, and do not arrive at their full growth until three or four years have passed.

Owing to the colouring of the skin, to which allusion has been made, the tiger can with difficulty be discovered, even when its haunts are known. Hunters

say that a tiger can hide itself in places where a rat could hardly find cover.

Practised hunters are always on the look-out for indications of the tiger's presence, one of which is a bush covered with berries. If no tiger were hidden there, the monkeys would not have left a berry on the bush, but as from their strongholds in the treetops they can see the enemy, they take care to keep their distance, and so let the berries remain on the branches.

Peacocks, again, are mostly found in places where the tiger lives. The bodies and feathers of dead pea-fowl are sometimes found strewn about a tiger's den. The natives account for this fact by saying that the tigress teaches her growing cubs how to hunt prey for themselves, and that they practise on peafowl before they can aspire to antelopes or cattle.

As to the size of a full-grown tiger, it varies almost as much as does the height of man. The average length of an adult male tiger is about nine feet six inches, measured from the tip of the snout to the end of the tail. A ten-feet male is as unusual an exception to the ordinary dimensions of tigers as is a man six feet three inches in height among ourselves. Measurements of the skin after it is removed from the animal are quite fallacious, a skin being capable of almost any amount of extension by stretching. To be worth anything, the measurements should be made before, and not after the skin has been taken off.

It is a curious fact that the mother does not seem so careful for the welfare of her offspring as is usual among animals, but, if she suspect danger, will often send her cubs on first, in order to see whether the path be clear. Experienced hunters, aware of this, refrain from firing at the young, knowing that the mother is behind, and will soon make her appearance.

NEXT in order is the Leopard (*Leopardus varius*), which is found both in Asia and Africa. It is by no means as large and powerful as the tiger, but is even more graceful in its movements. The colour of its fur is a bright golden yellow, closely studded with rosette-shaped dark spots.

A few leopards have been occasionally found whose fur was so dark as to earn them the title of Black Leopards, which were for some time supposed to constitute a separate species. However, it was found that the dark spots were still dimly visible, and that, except in point of colour, there were no particular differences between these black leopards and the ordinary animal, and that therefore they could only be considered as a mere variety of the common species.

To the leopard belongs a power which is not possessed by the lion and tiger—namely, the ability to climb trees. So quick and agile are its movements among the branches that it is even able to chase and capture the various tree-frequenting animals in their native haunts.

In some ways the leopard is even more dreaded than its larger and more savage relatives, especially by the farmers, who suffer greatly from its depredations among their flocks. Combined with great agility, it possesses the craft and cunning of the fox, and, like that animal, usually selects the hen-houses of the neighbourhood for its nocturnal raids. In these it commits the greatest havoc, striking the birds to the ground before they are even aware of the presence of their enemy, and following them into the trees should they roost among the branches.

The mischief he commits is rendered even greater by his custom of storing up provisions for a rainy day. For this purpose he usually selects the junction of a large branch with the tree-trunk, and constitutes this his larder, which he carefully conceals by means of dead leaves, etc. He has even been known to carry the body of a slain child into the fork of a tree, and hide it there.

When on the look-out for prey, the leopard generally conceals himself among the branches of some tree beneath which game is likely to pass. From his leafy

retreat he can then leap down upon the unfortunate animal, and bring it to the ground merely by the force of his spring. When hunted, too, he almost always takes refuge among the boughs of a tree, and displays great sagacity in selecting a spot where he is protected from the aim of his pursuers.

On ordinary occasions the leopard is a much more timid animal than most of his relatives, and is easily frightened if taken by surprise. When driven to bay, however, he fights with the greatest ferocity and desperation, dashing savagely at his foes, and wreaking his vengeance upon them with tooth and claw.

In consequence of this fierce disposition, a native who has killed one of these animals is held in the highest esteem by the rest of his tribe, who regard with envy the necklace of the teeth and claws, and the 'kaross,' or cloak, which he forms from the skin. The tail, too, is carefully preserved, and dangles from the string which passes round the waist of the successful hunter.

During all its ravages, the animal behaves with a caution which renders it a very difficult matter even to trace the marauder.

He will not approach a farm where he can detect the least sign of the presence of danger, and is even cunning enough to take up his quarters near one village, and commit his depredations in another at a considerable distance, in order to lessen the chance of his retreat being discovered. He often removes to a distant part of the country, too, if he has committed many ravages in his old locality, and fears that he may be in danger in consequence.

Although the size of the leopard is far inferior to that of the lion or tiger, its strength is very great when the dimensions of the animal are taken into account. One of these creatures has even been known to drag a couple of wolf-hounds, which were tethered together, for a considerable distance into the bush, in spite of their struggles. Animals far larger and heavier than itself, too, fall victims to its attacks, and are carried away without apparent difficulty.

The muscular force which is compressed into a leopard's body is really amazing. In his "Eight Years in Ceylon," Sir H. Baker has the following remarks on it:—

"The power of the animal is wonderful in proportion to its weight. I have seen a full-grown bullock with its neck broken by a leopard. It is the popular belief the effect is produced by a blow of the paw: this is not the case; it is not simply the blow, but the combination of the weight, the muscular power, and the momentum of the spring, which render the effects of a leopard's attack so surprising. . . . .

"The immense power of muscle is displayed in the concentrated energy of the spring. The leopard flies through the air, settles on the throat, usually throwing his own body over the animal, while his teeth and claws are fixed on the neck. This is the manner in which the spine of an animal is broken, viz., by a sudden twist, and not simply by a blow."

The same author mentions that he once found a Malabar lad sitting under a tree and looking very weak and ill. He sent some of his men to bring the lad to his house, but when they reached him they found that he was dead. He was buried by the roadside, but a few days afterwards it was found that the leopards had discovered the buried body, dug it up, and devoured it. The footprints, which were quite fresh upon the damp soil, afforded unmistakable evidence against the offenders.

Leopards seem to be one of the many hindrances to agriculture in Ceylon.

They are so cunning that it is hardly possible to take effectual precautions against them, and they can hide themselves so easily in the almost impenetrable jungle, that to extirpate them is a hopeless task, unless the whole of the jungle be cleared away. Even then, so great is the power of vegetation, that the neglect of two or three months will permit the jungle to replace itself by fresh growths.

Cattle can hardly be considered safe even when fastened into their houses, for the leopards will clamber on the roof, tear away the thatch, and so gain admission to the shed. Once inside, a leopard will kill every animal in the shed, not for the purpose of satisfying its hunger, but from the mere lust of slaughter.

The cunning of the man-eaters is proverbial. One favourite manœuvre is for the animal to show itself at one end of a village, and make a sham attack upon it. When it has drawn all the armed men in pursuit, it quietly sneaks away, skirts the village under cover, slips in at the other end, pounces upon one of the inhabitants—generally a child—and escapes with its prey into the bush.

The young of the leopard vary from one to five in number. They are pretty little creatures, and as playful as kittens, gambolling with their mother in just the same manner. For the first few weeks of their life the markings are very indistinct, but become more conspicuous as the animals grow older.

Like most of the members of the cat tribe, the leopard has occasionally been tamed, and has sometimes even been allowed to range the house at will, after the manner of a favourite cat. All these animals, however, have been captured when very young, before their savage instincts have had time to show themselves.

This animal is sometimes known as the Panther, the two being merely very slight varieties of the same species.

(*To be continued.*)

—o—

'How I Teach Elementary Science.'

FOURTH-SCHEDULE SUBJECTS: MECHANICS.

BY RICHARD BALCHIN.

IN last month's issue the reader will find a detailed course of lessons in the first stage of this subject. I purpose in this article reproducing, as far as I am able to remember, one of these lessons, given by me before certain members of the London School Board, H.M. Inspector, and others interested in science-teaching. Subject: 'Matter.' The class consists of about sixty boys in Standards V. and VI. The class-room is light and airy, and the sun is shining brightly through one of the windows. In another room the girls are singing; we can just hear them, for their window is opposite ours. Their voices sound very sweetly. The song happens to be 'Catch the sunshine.' On the table before the boys I have a piece of chalk, a piece of quartz-rock, and a small bundle of

loose wool, such as the School Board for London supply with their specimens for object-teaching. The blackboard is up, and empty. I begin the lesson.

Listen, boys! (the boys attend, for there is something to attend to). What can you hear? Ans.—The girls singing. Where is the sound coming? Ans.—Through that window. How do you know that? Ans.—We can hear it. Can you see the sound coming through? Ans.—No. Can you feel it with your hands if you hold them up to the window? Ans.—No. What is coming through the window opposite? Ans.—The sunshine. Can you see it? Ans.—Yes. Can you feel it? Ans.—No. Yes (says a boy who has just put his hand up into the rays). Some boy says he can feel the light. Can he? Ans.—No, sir, he can't feel the light; it's the heat he can feel. What *is* it, my boy, you can feel—the heat or the light? Ans.—The heat. Can you feel the light? Ans.—No, sir, but I can see it. Now, my boy, put this piece of quartz in your open hand; put your other hand in the sunshine. Can you feel the quartz? Ans.—Yes. Can you feel the heat? Ans.—Yes. Now close your hand on the rock; shut your hand. Can you feel it? Ans.—Yes. Now shut your other hand on a piece of the heat. Ans.—I can't, sir. Why not? Ans.—I can't lay hold of it. Listen again, boys! What are the girls singing? Ans.—'Catch the sunshine.' How can you catch the sunshine if you can't lay hold of it? Ans.—Mr. Forster told us that was poetry and had another meaning. Just so. It has. Tom Chumly, will you go and ask Mrs. Young to give you a piece of that sweet song that her girls have been sending through our window? Why do you smile? Couldn't you bring a piece? Ans.—No, sir. Why not, would it be too heavy for you to carry? Ans.—No, sir, not that. Mrs. Young could not get a piece, and I could not lay hold of a piece. Then it is not because it is too heavy? Ans.—No, sir, it has no weight at all. Just so, it has no weight at all. Now that boy who has been holding the piece of quartz; open your hand and move your arm up and down. Has the quartz weight? Ans.—Yes. What was the other thing you felt just now? Ans.—The heat of the sun. Move your hand up and down in that. Has heat weight? Ans.—No, sir. How could I show you with this piece of rock that heat has no weight? Ans.—If you make it hot it won't be any heavier than it is now. Just so. Now, boys, we have been talking about three things: sound, heat, and light. What have we said about sound? Ans.—You can hear it, but you can't see it, nor carry it about. What about heat? Ans.—You can feel it, but you can't see it nor carry it about. (Another boy), Please, sir, you *can* carry it about. Can you? Ans.—Yes, sir. If I make a poker hot, I can carry it about. (Another boy), It's the poker he carries about, not the heat. (Another boy), Please, sir, it's the poker and the heat too; it's both. Now, my boys, we won't settle that now, because you don't know at present what heat really is. One thing you are certain about: heat has no weight. Now what have we said about light? Ans.—You can see it, but can't feel it. Has it weight? Ans.—No. Tell me some other things in this room that have weight, besides that piece of quartz. Ans.—Chalk, slate, wood. Has the water in that jug weight? Ans.—Yes. Now is there anything in this room that you can feel and it has weight, and yet you can't see? No answer? (I wave my hand about.) What is it I feel? Ans.—The air. Yes, you can't see air, but you can feel it, and it has weight. (A boy puts up his hand.) Well? Please, sir, you can't weigh a bit of air! (Another boy), He says you can't weigh a bit of hare, but you can. Yes, he sounded an 'h,' but he meant the air we breathe; and he says you can't weigh it. But we can. And all the air around our earth presses with a very great weight upon the earth. I have told you before what that pressure is. (A boy), It is 15 lbs. on every square inch. Yes. Now you have told me of many things that have weight, such as chalk, wood, water, air. I will write on the board a word which means having weight: 'Ponderable.' Chalk is: (boys ans.) ponderable; wood, water, and air are: (boys ans.) ponderable. I will write under that word another, which means not ponderable, or not having weight. Perhaps, however, some of you can tell me the word I want. Ans.—'Light.' No, that is not the word. Ans.—'Unponderable.' Ah! that is very near. This is the word: 'Imponderable.' Now tell me some things that are imponderable. Ans.—Sound, heat, light. (A boy), Please, sir, is electricity imponderable? Well, what do you think yourself? Ans.—I think it has no weight. Why do you think so? Ans.—Because when you charge a Leyden-jar, or fill it with electricity, the jar is no heavier. (Another boy), Please, sir, he says when you fill a Leyden-jar with electricity, as if you put something into the jar when you charge it. But Mr. Allen told us you don't put anything in at all, you only change something that is already in, so of course it does not weigh any heavier. Well, boys, so far as we know at present we can say that electricity, like sound, heat, and light, is imponderable. Now I will write another word in a line with ponderable, the word 'Material'; and opposite Imponderable, I will write 'Immaterial.' 'Material' means nearly the same as ponderable, and 'immaterial' nearly the same as imponderable, so that we can call chalk, wood, water, and so on, 'material things,' and sound, heat, light, and electricity, 'immaterial things.' Now what parts of speech are all those words I have written on the board? Ans.—Adjectives. I will now write upon the board a noun, which will include all ponderable material things. This is the word, 'Matter.' Tell me now what things are included under the term matter. Ans.—Chalk, wood, slate, water, air, and many others. Now tell me some things that you would not call matter. Ans.—Sound, heat, light, and electricity. Look here, boys. Here is a small piece of chalk in my right hand, and a large piece of loose wool in my left. Tell me which hand holds the most matter. Ans.—Left. Right. Most of you say left hand. Frank Hawkins, you said left hand; why do you think so? Ans.—Because the piece of wool is larger than the piece of chalk. Well, then I will roll up and squeeze the wool into a very small space. Is there now less matter in my left hand than there was before? Ans.—No, sir, just the same. Very well. Now, suppose I were to press the piece of wool into a very little bit, no larger than the piece of chalk, then which hand would hold the most matter? Ans.—Both the same. Ah! But are you sure of that? (Another boy), Please, sir, you can't tell by looking at them. Why not? Ans.—You must weigh them and see which is the heavier. Just so, and the one that is the heavier has the greatest amount of matter. What does, therefore, the amount of matter in anything depend upon? Ans.—Weight. What does it not depend upon?

Ans.—How big it is. Yes, that is true. Now, boys, take out your book and write down a definition of matter. I will write it on the board. You copy it. 'Matter is everything that is ponderable, and can be carried about, such as chalk, water, and air. Sound, heat, light, and electricity are not matter. The amount of matter is measured by weight, and not by volume or size.' (End of lesson.)

There are two or three points in connection with the above I should like to remark upon. It will be seen that I have tried to give the boys a conception of what is generally meant by matter, before giving a definition of it. I find that nine out of ten teachers would have begun by giving a definition of matter, and gone on explaining the definition. But surely knowledge does not enter the mind of a boy, nor indeed of anybody else, in this way. What is the use of giving a verbal definition of something of which the conception is not yet formed? What *is* a definition but the drawing, as it were, a line, mentally, round an idea so as to exclude other ideas? But why trouble yourself to draw a line round nothing? Again, it will be seen that I do not enter into metaphysical disquisitions about mind and matter. Nor say of mind, that it is 'no matter,' nor of matter, 'never mind.' These belong not to 'Mechanics.' I always encourage, too, a little conversation among the boys, for this brings out their intelligences.

—o—

'A Talk about Language and Grammar.'

(*Continued from page* 224.)

BY MARTIN F. TUPPER, D.C.L., F.R.S.,

Author of 'Proverbial Philosophy,' etc.

Let us talk, then, about sundry other hard words, with the hope of making them easier by being understood; which means, making ourselves happy masters, rather than wretched slaves, of the uncomprehended. Knowledge is power, and he who has knowledge can stand up calm, strong, and self-possessed against the foes which ignorance alone has rendered formidable. Sometimes, one has been tempted to think of the 'good old times' gone by, learned men seem to have tried to get and to keep a monopoly (or selfish appropriation) of learning, by hiding up things that are simple and clear of themselves in words of definition that are complicated and obscure; but our day is happily the season wherein every one who can do so does his generous utmost to unveil mysteries and to destroy monopolies. It is the spirit of the age to be progressive; and, instead of trying to keep others back that we may seem to be in advance of them ourselves (however stagnant in fact and stationary), our wisdom, as our duty, is to keep the lead by a genuine progress, thus continually to be helping and urging others, especially the young, to reach us, or to beat us if they can, in the race of learning and intelligence.

Syntax: there's a terrible word, that utterly puzzled me for years, and has never been systematically explained to me to this hour. A poor little schoolboy on his hard bench on a cold winter's morning gets mystified as to the combination of vague thoughts about sin and tax,—and to him those six letters are fearsome, because unintelligible. Let me make the hard word clear to you at once: it simply means combined arrangement; 'syn' in Greek being 'together,' and 'taxis,' drill or order. So, then, the syntax of grammar is the order of language or the drill of words; and its rules are the regulations of the drill—for instance, a verb must agree with its nominative in number and in person, that is to say, it is according to law to say I run, and not I runs; he runs, and not he run. If I is the first person, run must agree with it; if I is a noun singular, then run must be a verb singular, and so on. Sundry grammar-makers head lists of exercises with this learned-looking brace of words, 'Parsing Praxis,'—a contemptible alliteration, or play upon letters. But it is easy to kick over this stumbling-block by telling you that Praxis means practice (a word derived from the Greek 'prasso,' I do, or I make), so now you need not be afraid of Praxis; and Parsing is a corrupt Latin-English word explained before. 'Exercise' is a word familiar to your ear, but it will be clearer to your mind by the explanation that 'Exercitus' in Latin means an army,—a combination of 'ex,' out, and 'arceo,' I drive, also perhaps, 'arcus,' a bow; exercise, then, in its first or literal intention, means drill, or regular motions proper to good soldiership; in its second, or figurative intention, it signifies systematic exertions leading to good scholarship. I wonder whether boys are still as bothered as I was in my young day by the unexplained words Prosody, Dactyl, Spondee, and the like. A few sentences in plain English will clear them up for us here.

As Syntax regards the order and character of words generally, so Prosody regards the order and structure of words, with a special reference to what we call poetry, or rhyme and rhythm; whereof I have somewhat to say presently. Prosody is a word which conveys two ideas to the ear of a Greek, according as the second 'o' in the word is pronounced with a long sound or a short one, and spelt with omega or omicron. In the first case, Prosody means an introduction to poetry, 'pros,' to, and 'odē,' an ode; in the second, Prosody means introduction to the way, as if leading up by a path to the hill of Parnassus, where the old poets fabled the Muses to live, 'pros,' to, and 'odos,' a way. Temples of yore were placed usually on the top of some hill, and when the procession went up the hill with a hymn or a chant, it was called a Prosodia. Hence the word used, so enigmatically to the uninstructed schoolboy (ay, and the usher too, in our grammars.

Now, as to the common words poetry, rhyme, and rhythm, let me give you a thought or two. The term Poetry is a Greek noun, 'poiēsis,' an acting or making, from 'poieo,' I do; Poet, 'poiētes,' means a maker or creator. So Poetry, as a word, involves a creation, which is 'a caution' (as our American cousins say) to a great many rhymers who think themselves poets. I have no time nor space, in this discursive talk, to give you an essay about every topic that arises, so we mustn't digress (or step aside) to enlarge upon such a wide subject as Poetry; only a word or two about rhyme as different from rhythm. Rhyme is the characteristic of most of our modern poetry—blank verse of course excepted—and rhythm is exclusively the characteristic of the ancient, which, inexplicably enough, was (until comparatively recent times) ignorant or contemptuous of the art of rhyming. Rhyme aims at a special melody or similarity at the

end of lines, the key to it in English being consonantal and not vowelic; and we in England reject exact similarities, while the French approve them. Rhythm aims at melody throughout, and is, when well done, intentionally diversified to escape monotony or sameness, by variations or modulations; of course, both rhyme and rhythm being best exhibited in the choicest forms of poetry. Milton's *Paradise Lost* is a rhythmical poem; his *L'Allegro*, a rhymed one. Virgil's poetry, as also Ovid's, Homer's, Sophocles', and the rest of the classics are exclusively rhythmical. Many old monkish hymns (as *Dies iræ, dies illa, solvet sæclum in favillâ*, etc.) are rhymed; the art appearing first as a modern discovery, quite unknown to the ancients, somewhere about a thousand years after Christ, and probably found out in chantries, or by wandering troubadours; but of this large and curious subject I may possibly write a paper hereafter by itself.

I have now, however, to explain the common words so frequently used in prosody (along with sundry others less common—as 'iambus,' a halting, and 'trochee,' a running metre)—as, let us instance, dactyl and spondee. They are excellently well-adapted names, when one knows the reasons for them. 'Dactylus' is the Greek for a finger, made up, as we all know, of one long joint and two short ones: so with the syllables of dactylic words: Omnibus (a Latin word meaning 'for all,' and now adopted as English for a public conveyance) is a dactyl. 'Spondee' is the name given to all words made up, as the word spondee itself is, of two long syllables; its adaptation is curious, and you will be interested to know about this word something that very few of the old schoolmasters even were aware of. Spondee in Greek means a libation, or religious outpouring; the hymn with which it was poured out was of long-drawn syllables, in psalm-tune or minim slow-time style, and was called 'Spondœum melos;' so the bars, or feet, or sections of the hymn came to be called spondees—in English, such a word as railroad, or steamboat, or concord is a spondee. Of other measures and verses I may possibly talk hereafter. It is a pity for English learners, be they older or younger, when a teacher does not habitually expound to them all such difficult words; half the obscurities of any science lie in the terms wherein knowledge is mysteriously hidden.

Diphthong, for instance, an ugly-looking word enough, baffling both to spell and to enunciate, which has perplexed many a small boy, merely signifies a double sound, being the combination of two vowels—as a and e, æ; o and e, œ, and so forth; 'Di' standing for double in Greek, and 'phthong' for voice or vowel. Even the common word 'syllable' (though tolerably well understood to mean one connected span of a vowel surrounded by its consonants) is seldom shown to a child to be made up of 'syl,' with, and 'lable,' taken, or Greek words much like these. So the word means taken with, or caught together; any vowel entangled in consonants is a syllable. Monosyllable means one such small collection of letters, 'monos' being the Greek for one or single—as monopoly, one trading; monolith, one stone pillar, etc. Dis-syllable means two such lots of letters; Tris-syllable, three, and so on. Now, the word 'declension' will convey a truer idea to your minds than you may hitherto have had of it, when you know that it means 'a going down,' as on the steps of a ladder; there are, as it were, five shelves of Latin and Greek nouns, ranked according to the five vowels severally influencing each of them, as before mentioned; and upon one or other of these five shelves all the classic nouns are pitched, the first declension being at the top, and the fifth at the bottom. So, likewise, with verbs, also classified by vowels, as keynotes; the word 'conjugations' may be illustrated by the word 'bunches,' being joinings together of similar verbs in bundles; each verb also, when conjugated throughout, being like a bunch of grapes, or a genealogical tree, or bees swarming—'con,' together, and 'jungo,' I join. There is plenty of hard words about the verbs; let me, just as the thoughts occur in talking, touch some of them: for instance, a 'transitive' verb is one, the influence or action of which passes over ('trans,' over, 'it,' goes) to some noun beyond the nominative—as 'John loves me;' where 'loves' is transitive, as its action extends from John to me, but if I say simply 'John loves,' without expressing whom he loves, and only as another way of saying 'John is in love,' there 'loves' is intransitive; the Latin word 'in' meaning 'not'—instance, incorruptible, innumerable. 'Tom killed a sparrow'—killed is transitive; 'Tom absconded'—absconded is intransitive. A neuter verb is one neither transitive nor intransitive, but betwixt and between—as 'I am,' 'we are,' etc. A *tense* means a time, corrupted from tempus; of tenses I will speak anon. A *mood* means a manner, modus; of the moods also hereafter. But some words, as these two, 'Gerund' and 'Supine,' are mysteries to most of us through life; they mean powers of being active or idle. The famous distich wittily expresses the three Gerunds di, do, dum:—

'When Dido saw Æneas would not come,
She wept in silence, and was Dido dumb.'

I can throw very little light on the Supine—the letter 'u seems its keynote. Now, as to tenses or times: there can be only three sorts of time—the past, the present, and the future—and in every sentence we utter, the verb or principal word in it must be used in one or other of these three. Accordingly, in every language (for Grammar is a universal science) the times or tenses are either the present—'I am doing;' the past or perfected—'I have done;' or the future—'I will do;' there are, also, more or less additionally, certain shades of difference as to the past, with reference to its distance from us now, as the imperfect—or less than perfected past—'I was doing;' and the pluperfect—or more than past—'I had done;' the Latin word 'præter,' besides, usually prefixed to these names, meaning 'extra' tenses. The future might undoubtedly also have been endowed with similar shades of difference, affecting its nearness or distance, but, as we are none of us prophets, these could not be defined with the exactness wherewith we can contemplate the historic and completed past. As to the present, it can only be one phase in its severe simplicity.

But there are other variations of the verb, called moods or modes, methods whereby and wherein we must use them—for example, we either indicate a fact, as 'I run,' or command it impressively, as 'Run thou;' or express a desire with reference to it, as 'May I run!' or conditionally, 'I might run,' in a sort of subjoined fashion; or to speak of it indefinitely, as 'To run.' All these are various acknowledged

moods or modes of using the verb. So, also, there are possibilities of employing the principal word in a sentence in an active way—as 'I love,' 'I strike;' and in a passive way—'I am loved,' 'I was struck:' these two are called the verb's voices; in the first, as it were, speaking out loudly, in the latter, as humbly whispering.

In the classical tongues, it seems very probable that the conjugations or bundles of verbs were arranged in some naturally selecting fashion, according to the preponderance of their vowels or vocal sounds, much, as I have hinted before, in the case of the declensions or classes of nouns. For instance, in the first conjugation, we all know how much the letter 'a' predominates—'amare,' etc.; and the long 'e' in the second—'monere,' 'habere,' etc.; and the short 'e' and short 'i' in the third; and the long 'i' in the fourth; while the first form of the verb always has 'o' at its termination, and the supines claim the less used 'u.' Thus all the vowels are taken care of, and, as it were, crystallize separately; being each the keynote of a variation of verbs: here, then, is something of a reason for these conjugations or classifications.

But space warns me that I must have done for the present. We have had a familiar talk together about grammar and language, one thought suggesting another in a most discursive fashion, so as almost to be called gossip. By the way, shall I tell you the meaning of this word? It will be new to most folk. Gossip is the old name for a sponsor, a God'sschip; many old people in far-away villages are still called Gossip So-and-so; and as such ancient gaffers and crones were apt to be garrulous, the word 'gossip' came to be used for rambling talk. Some day, with permission, I may speak in a like fashion of other educationals; let this suffice for to-day as my talk on the elements of grammar and language.

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'How I Teach Arithmetic.'

(*Continued from page* 226.)

BY WILLIAM SPENCER,
Author of 'Spencer's Exercises in Arithmetic.'

We will take only one more example from Colenso, the last in the article on Fractions.

(11) A person dies worth £10000, and leaves $\frac{1}{3}$ of his property to his wife, $\frac{1}{2}$ to his son, and the rest to his daughter. The wife at her death leaves $\frac{3}{5}$ of her legacy to the son, and the rest to the daughter; but the son adds his fortune to his sister's, and gives her $\frac{1}{3}$ of the whole. How much will the sister gain by this, and what fraction will her gain be of the whole? (No. 50, Art. 36.)

£10000 ÷ 3 = £$3333\frac{1}{3}$, wife's share.
£10000 ÷ 2 = £5000, son's ,,
£10000 − $8333\frac{1}{3}$ = £$1666\frac{2}{3}$, daughter's share.
$\frac{3}{5}$ of £$3333\frac{1}{3}$ = £2000, son gets from mother.
£$3333\frac{1}{3}$ − £2000 = £$1333\frac{1}{3}$, daughter ,, ,,
£5000 + £2000 = £7000, son's total.
£$1666\frac{2}{3}$ + £$1333\frac{1}{3}$ = £3000, daughter's total.
£7000 + £3000 = £10000, fortunes added.
£10000 ÷ 3 = £$3333\frac{1}{3}$, daughter's now.
£$3333\frac{1}{3}$ − £3000 = £$333\frac{1}{3}$, daughter's gain. Ans.

As £$333\frac{1}{3}$ is $\frac{1}{3}$ of £1000, it is of £10000 the tenth part of $\frac{1}{3} = \frac{1}{30}$. Ans.

In explaining the above question, I should point out that there are six distinct operations—(*a*) dividing the money among the 3 on the father's death; (*b*) dividing the mother's between the son and the daughter: (*c*) amalgamation of the shares of son and daughter; (*d*) new division of the amount; (*e*) excess of the daughter's new share over the two amounts she had previously received; (*f*) finding the fraction that this excess is of the whole amount left by the father.

We will complete the round dozen of these worked-out questions by taking the last question set for Female Pupil Teachers, Second Year, at the last examination, March 1881.

(12) If I pay away $\frac{1}{3}$ of my money, then $\frac{1}{2}$ of what remains, and then $\frac{1}{4}$ of what still remains, what fraction of the whole will be left?

We will find the fraction of the *whole* paid away each time, then add these three fractions together, and deduct the result from *one*.

First payment = $\frac{1}{3}$ of the whole.
$\frac{3}{3} - \frac{1}{3} = \frac{2}{3}$ left after first payment.
Second payment = $\frac{1}{2}$ of $\frac{2}{3} = \frac{1}{3}$ of the whole.
$\frac{3}{3} - (\frac{1}{3} + \frac{1}{3}) = \frac{1}{3}$ left after the second payment.
Third payment = $\frac{1}{4}$ of $\frac{1}{3} = \frac{1}{12}$ of the whole.
Hence $\frac{1}{3} + \frac{1}{3} + \frac{1}{12} = \frac{9}{12} = \frac{3}{4}$, total paid.
And $1 - \frac{3}{4} = \frac{1}{4}$, fraction of whole left. Ans.

Any girl fairly up in fractions would easily work this question purely mentally:—I pay away $\frac{1}{3}$, then I have $\frac{2}{3}$ left, the half of which is another third; hence I have paid away $\frac{2}{3}$, and consequently have $\frac{1}{3}$ left, $\frac{1}{4}$ of which is $\frac{1}{12}$; then I have paid away $\frac{2}{3}$ and $\frac{1}{12}$, that is, $\frac{9}{12}$ or $\frac{3}{4}$, and must therefore have $\frac{1}{4}$ left.

We here close our remarks on the *teaching* of Fractions, but as before observed, we shall embody their principles and operations in dealing with Compound Proportion, Percentages, etc.

As the natural sequel to *Vulgar* Fractions is *Decimal* Fractions, which for brevity are generally coloquially called 'Decimals,' I at once proceed to my mode of teaching them. First, show clearly the distinction in the representation of a vulgar fraction and a decimal fraction. In the former the denominator is *expressed* by, and can be, any number whatever, while in the latter the denominator is only understood—not expressed, and can only be *ten* or some *power* of ten; but is represented as any whole number (integers), with a full-point, called the 'decimal point,' placed to the left of it. Thus in the vulgar fractions $\frac{2}{3}$, $\frac{7}{16}$, $\frac{9}{125}$, $\frac{7}{10}$, $\frac{47}{100}$, $\frac{121}{1000}$, the denominators have no determinate relation to each other in the first three given, but they have in the last three, and these can be expressed decimally as ·7, ·47, and ·121. In order to read off these decimals correctly, we consider the figures given as the numerator in each case, and the imaginary denominator to be as many ciphers as the given figures, with a one placed to the left of them. Hence ·7 = $\frac{7}{10}$, ·47 = $\frac{47}{100}$, ·0197 = $\frac{197}{10000}$, ·0003 = $\frac{3}{10000}$, etc.

We will proceed step by step as in vulgar fractions, interspersing any incidental remarks as they casually suggest themselves as we go along, rather than here formally attempting a general dissertation on the theory and utility of decimals.

(*a*) We begin by *adding* decimals together—(1) ·77 + ·085 + ·7825 + ·00185. (2) 6·018 + 8·2 + ·0005 + 4·4. (3) 8·007 + ·8007 + ·08007 + 80·07.

(1)	(2)	(3)
·77	6·018	8·007
·085	8·2	·8007
·7825	·0005	·08007
·00185	4·4	80·07
1·63935	18·6185	88·95777

In putting down the numbers in column for adding, explain clearly that the figure next the point is so many *tenths*, the next *hundredths*, the next *thousandths*, etc.—that every remove of a position from the point diminishes the value ten times. Thus in ·7777 the 7 next the point is 7 *tenths*, the next 7 *hundredths*, etc.; and in ·0875 we have *no* tenths, 8 hundredths, 7 thousandths, and 5 ten thousandths. In this number, as $·08 = \frac{8}{100} = \frac{800}{10000}$, $·007 = \frac{7}{1000} = \frac{70}{10000}$, and $·0005 = \frac{5}{10000}$, we have $\frac{800}{10000} + \frac{70}{10000} + \frac{5}{10000} = \frac{875}{10000} =$ ·0875 as expressed decimally. Show also that this tenfold diminution in value as we proceed to the right, and tenfold increase as we proceed to the left, refers to whole numbers—as explained in working simple rules—as well as to decimals. Take (say) 888·8808 and 750·080575 and make exhaustive remarks on the value, both relative and absolute, of each figure in each of the numbers, showing that by proceeding indefinitely from the point to the *left* we can express numbers inconceivably great, and by continuing the figures from the point to the *right* we can go down to any infinitesimal minuteness. From the above remarks it will be obvious that the decimal points in addition, and by anticipation in subtraction also, will in each case come directly under (or over) each other, forming a column as shown in the position of the figures for adding up. A boy would scarcely need telling that the figures to the *left* of the point are whole numbers. I would here emphasize the importance of making beginners *read* the decimal figures, *e.g.*, to read out ·018, as *eighteen thousandths*, not say 'cipher, one, eight; ·00185 read as one hundred and eighty-five *hundred thousandths*, etc. Unless this is done in the earlier stages of teaching, a boy is apt to call out the figures without the slightest appreciation of their significance. When a boy is fairly up in decimals, and has become familiar with them, this *reading* of the figures may generally be dispensed with, except as an occasional test of his mental grasp of the real meaning of the figures.

(*b*) The *Subtraction* of decimal numbers is so simple that little explanation is required, the smaller number being merely placed under the larger, so that the two points are directly vertical. Example, (1) from ·185 take ·09375; (2) take ·8082 from 2·15; (3) from 17·0841 take 5·983.

(1)	(2)	(3)
·185	2·15	17·0841
·09375	·8082	5·983
·09125	1·3418	11·1011

Here caution the learner against concluding that the *number of figures* employed determines the *magnitude* of the number represented—·09375 is less than ·185, as the former is not a tenth and the latter is more than a tenth. As in working the first two of the above exercises ciphers have to be added to the minuend, it might now be explained that ciphers added to the right of a decimal number do not affect its magnitude—that ·5, ·50, ·500, ·5000, etc., are all equal, since if each be represented as a vulgar fraction and then reduced to its lowest terms, the result in each case will be the same, $\frac{1}{2}$. Illustrate by a few more similar examples, *e.g.*, ·35, ·350, ·3500, etc.; ·085, ·0850, ·08500, etc. The boys are agreeably surprised at the simplicity of working addition and subtraction of decimals, compared with the labour required in working them in vulgar fractions, where a common denominator must be obtained. Again, further explain here, or rather reiterate, that as tenths, hundredths, thousandths, etc., respectively fall directly under each other, and as they increase or decrease tenfold for each change of position, hence *the working in decimals is precisely the same as the working in whole numbers, the vital matter being the keeping of the point in the right position.* As this remark embodies a principle that holds good in all processes of working *determinate* (non-repeating) decimals, I accentuate it very forcibly in order that it may find a permanent lodgment in each learner's mind as a principle to fall back upon, and in his memory for practice in daily work. I find this necessary as beginners, and the feebler thinkers generally, are apt to convert decimals into vulgar fractions unnecessarily, under the erroneous impression that they can thus be more easily worked.

(*c*) Although the steps of the various operations in decimals need not necessarily follow each other in any prescribed order, the teaching of *multiplication* may conveniently follow subtraction. Here the process, or rather the rationale of the result and its value, is not so easily comprehended as in addition and subtraction. I generally proceed as follows in order to explain the principle by which the position of the point in the product is determined. Units × units give units, 3 × 2 = 6; tens × units or units × ten give tens—30 (3 tens) × 3 = 9 tens = 90; tens × tens give hundreds—50 (5 tens) × 70 (7 tens) = 35 hundreds = 3500. By the same parity of reasoning units × *tenths* or tenths × units give tenths—4 × ·7 = 28 tenths = 2·8; tenths × tenths give hundredths—·8 × ·9 = 72 hundredths = ·72; hundredths × tenths give thousandths—·89 × ·7 = 623 thousandths = ·623; thousandths × hundredths give hundred thousandths—·048 × ·35 = 1680 hundred thousandths = ·01680 = ·0168, ejecting the useless cipher. Now call the attention of the scholars to the fact that in each of these operations there is the same number of decimal figures in the product as there is in both the factors, and that this result is always apparent if we carefully consider the theory of the operation. Hence we educe the rule that in multiplying decimals *the product must have as many decimal figures as there are in both the factors*, and that if the product has not as many figures as the two factors have when multiplied together, ciphers must be added to the left of the product to complete the number. Examples, (1) ·48075 × ·605; (2) 8·43 × ·065; (3) ·035 × ·35.

(1)	(2)	(3)
·48075	8·43	·035
·605	·065	·35
240375	4215	175
288450	5058	105
·29085375	·54795	·01225

(*To be continued.*)

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add together six hundred and forty-five, three hundred and ninety-seven, eight hundred and fifty, forty-six, one hundred and fourteen, and seven hundred and eighty-two. Ans. 2,834.

(2) From eight hundred and fifty-two take seven hundred and ninety-six. Ans. 56.

(3) Take one hundred and eighty from four hundred and thirteen. Ans. 233.

Dictation.

school	**slate**	**window**	**cloud**
hand	**foot**	**tree**	**leg**
fire	**mouth**	**field**	**eye**

STANDARD II.

(1) Multiply eighty-six thousand four hundred and seventy-nine, by sixty-seven. Ans. 5,794,093.

(2) Divide fifteen thousand four hundred and thirteen, by seven. Ans. 2201 + 6.

(3) Take eight thousand one hundred and ninety from nine thousand and seventeen. Ans. 827.

(4) A spider has eight legs. How many legs have one hundred and seven spiders and one hundred and seven ducks? Ans. 1070.

STANDARD III.

(1) Take eighteen pounds thirteen shillings and elevenpence three farthings, from two thousand and one pounds twelve shillings and a farthing. Ans. £1982 18s. $0\frac{1}{2}$d.

(2) Divide four hundred thousand and sixteen by seventy-three. Ans. 5479 + 49.

(3) Add together eight shillings and twopence farthing, nine thousand pounds and a halfpenny, two pounds and fourpence, one hundred and ten thousand seven hundred and forty pounds sixteen shillings and threepence three farthings, seventy-seven thousand pounds seventeen shillings and fivepence halfpenny, two hundred and twenty-nine pounds thirteen shillings and eightpence, eighteen shillings and elevenpence farthing, and four hundred and four thousand and forty-four pounds fourteen shillings and fourpence three farthings. Ans. £601,019 9s. 4d.

(4) A boy has two thousand seven hundred and eighty-nine nuts. He gave fifty-eight to each of forty-seven playfellows. How many had he left for himself? Ans. 63.

STANDARD IV.

(1) How many square inches are there in four hundred and thirteen square poles? Ans. 16,191,252 sq. in.

(2) Divide £4040 equally among thirty-seven people. Ans. £109 3s. $9\frac{1}{4}$d. + 23.

(3) Multiply seventy-six pounds three shillings and sixpence farthing, by five hundred and sixty. Ans. £42,658 11s. 8d.

(4) I bought 7 yds. of cloth at 7s. 11d. per yd., and 9 yds. at 6s. $3\frac{1}{2}$d. per yd. What was the average cost per yd.? Ans. 7s. $0\frac{1}{8}$d.

STANDARD V.

(1) What will 407 yds. 2 ft. 9 in. cost, at 7s. 9d. per yd.? Ans. £158 1s. $4\frac{1}{4}$d.

(2) If a gentleman's income is £450 per annum, and at the end of the year he is seventy guineas in debt, how much would he spend in seventy-three days? Ans. £104 14s.

(3) Find by practice the value of two thousand nine hundred and sixteen chairs, the average price of each being four pounds seventeen shillings and ninepence farthing. Ans. £14,254 19s. 9d.

(4) Make out in proper form, and settle the following grocer's bill—

		s.	d.
$3\frac{1}{2}$ lbs. of tea @ 2s. 8d. per lb.	...	9	4
$\frac{1}{2}$ pint of oil @ 8s. per gallon	...	0	6
9 boxes matches @ 7d. per doz.	...	0	$5\frac{1}{4}$
2 bars of soap, each weighing $2\frac{1}{4}$ lbs., @ $3\frac{1}{2}$d. per lb.	...	1	$3\frac{3}{4}$
	Ans.	11	7

STANDARD VI.

(1) $\frac{22}{33}$ of £4 19s. — $\frac{12}{14}$ of £1 8s. Ans. £2 2s. 0d.

(2) A person bought a box containing a thousand oranges at sixteen a shilling, just before a rise in the price of threehalfpence a dozen. How much did he save? Ans. 11s. $0\frac{1}{2}$d.

(3) What decimal of two pounds ten shillings is three shillings and sixpence? Ans. ·07.

(4) If a man spends forty-seven pounds ten shillings in seventy-three days, and saves a hundred pounds a year, what is his annual income? Ans. £337 10s.

Grammar and Composition.

STANDARD IV.

Parse and analyse, if you can :—

(*a*) For him light labour spreads her wholesome store.

(*b*) And desolation saddens all thy green.

Write a short essay on the Horse.

STANDARD V.

Parse and analyse :—

(*a*) Amidst dry desert walks the lapwing flies.

(*b*) Along the lawn where scattered hamlets rose.

Give an account of any interesting tale you know.

STANDARD VI.

Parse and analyse :—

'This is the house that Jack built.'

Write a letter explaining any events and any characters given in the poetry you have learnt by heart.

Domestic Economy.

(1) What kind of clothing should be worn in summer, and what kind in winter? What is the best kind to have next your skin?

(2) Which is the more nourishing—salt or fresh meat? Why?

(3) State the uses of vegetables as food.

(4) What do you know about silk, and its uses as a clothing material?

THE FARMERS' BOYS.

Words by GEORGE BENNETT.* *Music by* T. CRAMPTON.

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The Practical Teacher.

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IMPORTANT NOTICE.

THE August and September issue (Nos. 6 and 7) of the *Practical Teacher* will contain the Scholarship Questions, July, 1881, with model answers to every question in every subject. *Early orders should be given to the Booksellers.*

☞ **In reply to numerous inquiries, the Editor begs to state that a Series of Papers of special interest to Schoolmistresses will shortly appear in this journal. The first will be entitled 'How I Teach Needlework.'**

Monthly Notes.

NATIONAL TRAINING SCHOOL FOR COOKERY.—A meeting of supporters of the National Training School for Cookery was held on the 20th June, at Devonshire House, Piccadilly, the Duke of Beaufort in the chair. Amongst those present were the Princess Mary, Mr. Lowell (the American Minister), Lord Houghton, the Duchess of Leeds, the Countess of Airlie, etc. The Hon. E. F. Leveson-Gower, in moving the adoption of the report, said that during the last year the total number of pupils who passed through the school was 2,112, which showed a considerable increase. Mr. Lowell, Mrs. Buckton, Mr. G. A. Sala, and others addressed the meeting.

VICTORIA UNIVERSITY.—The Council of the Victoria University have elected Mr. Arthur Schuster, Ph.D. (Heidelberg), F.R.S., to the newly-instituted Professorship of Applied Mathematics.

ROYAL GEOGRAPHICAL SOCIETY.—The concluding meeting of the session 1880-81 of the Royal Geographical Society was held on the 27th June, in the theatre of the University of London, the Right Hon. Lord Aberdare—President of the Society—presiding. The meeting was very largely attended, among those present being Major-General Sir H. C. B. Rawlinson, K.C.B., and Sir Frederick Roberts, K.C.B. Lieut.-Colonel C. E. Stewart, of the Bengal Staff Corps, read a paper on 'The Country of the Tekke-Turcomans and the Tejend and Uurghab Rivers.' The author described a journey made by him last year from Constantinople to Persia, travelling by Trebizond and Erzeroum, and after giving a *résumé* of the strength of the various Turcoman tribes, he proceeded to refer to the new Trans-Caspian province acquired by Russia. Every effort, he said, was being made to construct a railway as far as Bami, the new capital, and a line was also projected from the capital as far as Askabad. Though not what might be called a rich country, it was far from being a desert. The island of Cheleken, in the Caspian, was one abounding in several useful products, and it was contemplated to set up some manufactories there. As to the Turcomans themselves, everything they made, except money, was thoroughly good. In every village all spoke kindly of the Russ for doing away with slavery. At the close of the reading of the paper a discussion took place.

EDUCATION ACT.—Lord Coleridge and four other judges had before them, on the 27th June, the question whether a parent performed the duty imposed upon him by the Education Act, of giving his child efficient education, merely by sending the child to the doors of the school, without the school fees, the consequence being that admission was refused. The Court held that this did not carry out the object of the statute, which was to see that a parent did his duty, and caused his child to receive efficient elementary instruction. The payment of the fees prescribed by the Board, according to the Code, was a condition precedent of the child's entering the school.

LONDON ORPHAN ASYLUM.—The half-yearly election of children as inmates of the London Orphan Asylum took place at the City Terminus Hotel, on the 27th June, Mr. A. R. Capel in the chair. The report showed that the educational status of the school was in an excellent condition, as the whole of the seventeen candidates who were presented at the recent Oxford Local Examination passed successfully. The result of the science and art examinations was equally encouraging.

DOMESTIC ECONOMY CONGRESS.—The Domestic Economy Congress, in connection with the Society of Arts, was held in London during the fourth week of June, the sittings taking place in the rooms of the Society of Arts, and in the Royal Albert Hall. We

are sorry to state that the attendance at the meetings was throughout the week very small. The first session of the Congress met for business at 11 o'clock on the 21st June, in the large room of the Society of Arts. The chair was taken by the Countess of Airlie, Sir H. Cole, K.C.B., acting as assessor. The proceedings commenced by the reading of a paper, by Lady Stuart Hogg, on 'The Teaching and Superintendence of Women in Elementary Schools.' The paper advocated making compulsory the teaching in State schools of all subjects of practical utility, and was read for the author by the Rev. N. Price, M.A. A paper, which was the joint production of Sir H. Cole, the Rev. N. Price, and the Rev. J. P. Faunthorpe, was read by the latter, entitled, 'Suggested Outlines of a Plan for Establishing Woman's Inspection of the Teaching of Domestic Economy.' It proposed that all public girls'-schools, as respected the teaching of domestic economy, should be under the sole inspection of women. After a long discussion, Miss Barnett read a paper contributed by Mrs. Greenup, who proposed that the National School of Cookery should be transformed into a National Training College for teachers of domestic economy. After the reading of a paper by Mr. W. J. Harrison, Miss Brant read her prize paper, 'On the Teaching of Domestic Economy,' which, being accompanied by a remarkably graphic description of the cleaning of a room, was well received. Miss H. Martin then read a good practical paper on the subject of domestic economy in schools and training colleges; after which, Miss Lydia Becker, in a short speech, expressed her general agreement with the objects of the Congress, but at the same time strongly dissented from the proposal to introduce the compulsory teaching of domestic economy in elementary schools, objecting to it as involving class legislation. Miss Fenwick replied to Miss Becker, insisting on the importance of having the subject taught both theoretically and practically. Sir H. Cole and Rev. Mr. Faunthorpe supported the views of Miss Fenwick, after which the proceedings of the first day came to a close.

The Congress met on Wednesday, at the Albert Hall, in the morning, the attendance being again small. The chair was taken at 11 o'clock by the Duchess of Leeds, the Rev. N. Price acting as assessor. The proceedings commenced with a paper by Miss Stanley, on 'Needlework Certificates for Teachers,' which advocated the granting of special certificates for needlework; and which was followed by a paper by Madame de Witt, entitled, 'Some Remarks on the State of Needlework in the Primary Schools of France,' read by Miss Barnett. From the paper it appeared that much more is to be done in France in needlework than in other branches of domestic economy. After some discussion, and the reading of other papers, Miss Mallet read a paper written by Madame Van Eyk-Iardmann, on the 'Teaching of Plain Needlework,' which contained many valuable hints. After the reading of two papers, by Mrs. Erskene and Miss Curry, the morning sitting terminated. The afternoon was occupied by a lecture by Mrs. Floyer, entitled, 'Simultaneous Teaching of Needlework,' which was really a demonstration on the subject, and which proved very able and scientific. An evening meeting, held at the Society of Arts, was but thinly attended. Mrs. Mann occupied the chair in the absence of Lady Reay, who was unable to be present. Papers relative to cookery were read by Miss Martin, Miss Barnett, Mrs. Mann, etc., after which the Congress adjourned.

The sittings were resumed on Thursday, at the Royal Albert Hall, Mrs. Dacre Craven in the chair, and Dr. Mann acting as assessor. The proceedings began by the reading of an excellent paper by Mrs. Craven, on 'Warming, Cleaning, and Ventilation of Schools and Dwellings in London and Large Towns.' The reader drew attention to the deficiency in the means of ventilation in the dwellings of the poor, and insisted that instruction in the subject should be given to children in school. After some conversation on the subject, and the reading of one or two short papers, the Rev. Mr. Craven read a paper contributed by E. A. Hadley, Esq., on 'Pure Air and Cleanliness.' The writer affirmed that while the poor often complained of want of the means of well-being, they neglected to avail themselves of some of the most important within their reach. He thought that the poor should be educated to see the value of pure air. A paper by Captain Galton, on 'The Maintenance of Pure Air in Dwellings,' having been read, the morning sitting terminated. Mrs. Buckton re-delivered her lecture on cookery in the afternoon.

The Congress met on Friday in the rooms of the Society of Arts, under the presidency of Viscountess Strangford, Lord A. Churchill acting as assessor. In opening the proceedings, Lady Strangford read a paper on 'Teaching the Laws of Health in Elementary Schools,' in which she maintained that the introduction of domestic economy into the teaching of elementary schools was of the first importance to the future well-being of the people, morally and physically. Mr. J. J. Pope, M.R.C.S., followed with a paper on 'Health in Schoolrooms,' in which he very strongly condemned the underground schoolrooms connected with churches and chapels in London. Papers by Mrs. Sutherland Orr and Miss Twining were read, after which, Mrs. Priestly gave the Congress a description of a scheme for illustrating to the eye the different precautions to be taken for ensuring health. In the afternoon the Congress heard papers by Lady Stanley on 'Thrift,' and by Mrs. M. E. Townsend on 'The Girls' Friendly Society'—a society formed with the object of associating ladies and working girls together for mutual help, temporal and spiritual. Other papers of minor importance were also read.

The closing meeting of the Congress had, like its predecessors, a very small attendance. The Countess of Derby presided. A report to the Council of the Society of Arts was read from the Executive, who congratulated the Council upon the success of the Congress, recounted what had been done in the sections, thanked the Princess Christian, the Duchess of Leeds, the Countess of Airlie, the Viscountess Strangford, the Dowager Lady Stanley of Alderley, Lady Reay, Lady Stuart Hogg, and Lady Derby for presiding, and embodied the following conclusions:—'The success of this Congress is entirely due to the great and sympathetic interest which women, rather than men, have taken in it. The success is significant of the forthcoming change in the Education Code. Very few important female minds, thoughtful on women's home duties, and knowing how to teach them, have been absent. The success is immense for the forthcoming change in the Education Code which the Congress has advocated, and confidence may be expressed that public opinion will support the Lords of the Com-

mittee of Council on Education in realising such necessary change. Reports of the papers and discussions have been published daily, and they will be collected together hereafter. Some very able papers, having much scientific interest, but not especially appropriate to the teaching of domestic economy in elementary schools, the Executive Committee recommend should be published in the Society's journal. Before the conclusion of the Congress, strong convictions were expressed by the members unanimously that this Congress was only the beginning of a movement for connecting the knowledge of home duties with the earliest teaching of children by women, and securing that reform of the Education Code which has been promised by the Lords of the Committee of Council on Education. Accordingly a very satisfactory beginning has been made to collect funds for preventing interruption to the work of the Congress, and to hold another Congress in 1882, when it is hoped that the plan of a national institution, with local branches throughout the United Kingdom, may be matured and submitted to the Congress for approval. The Executive Committee have the great satisfaction of reporting that Her Royal Highness the Princess Christian has expressed her gladness at continuing at the head of this movement, which is of the very highest national importance to the welfare of all subjects of the Queen.' The usual votes of thanks were passed, that to Miss Webb, the Secretary, being especially deserved.

CITY OF LONDON COLLEGE.—A very important meeting was held on the 1st July, in the Egyptian Hall, Mansion House, in aid of the new Building Fund of the City of London College. The Lord Mayor occupied the chair, and was supported on the platform by the Bishop of Bedford; Mr. Mundella, M.P.; Mr. J. G. Hubbard, M.P.; Sir John Lubbock, M.P.; Sir E. H. Currie; Mr. Edward Clarke, Q.C., M.P.; Sir John Bennett, the Rev. Prebendary Mackenzie, etc. The Lord Mayor, in opening the proceedings, expressed the great pleasure he had felt in granting the use of the Hall for such an object, after which the Secretary (Mr. T. Beck) read a long list of letters of sympathy, including the names of the Duke of Connaught, Prince Leopold, the Archbishop of Canterbury, the Bishop of London, the Earl of Derby, Sir Stafford Northcote, M.P., Mr. Fawcett, M.P., etc.—Speeches were delivered in support of the institution by Mr. Hubbard, M.P.; Mr. Mundella, M.P.; Mr. Edward Clarke, Q.C., M.P.; and Sir John Lubbock, M.P.

COMPULSORY EDUCATION.—In the House of Lords, on the 4th July, Earl Fortescue presented some petitions praying that the limit of age for compulsory education might be lowered below fourteen, and that passing the third standard only, instead of the fourth, may be required of children as the condition of their being allowed to work for their living. His Lordship stated that his experience as Chairman of a Board of Guardians was constantly leading to this—that the keeping up of this limit was inimical alike to the industrial training of the children, and also to the interest of the ratepayers. He also commented strongly upon the business conduct of the Education Department. The Duke of Richmond and Gordon said his own opinion was that the management of the Education Department was excellent, in which sentiments Earl Spencer entirely concurred. The subject then dropped.

THE STEPHENSON COLLEGE.—The promoters of the Stephenson Centenary at Newcastle-on-Tyne have determined to commemorate the occasion by erecting, if funds can be obtained, a building in that town for the use of the College of Physical Science, to be called the Stephenson College. It is estimated that a sum of £20,000 will be required, and of this £2000 has been promised, Sir Wm. Armstrong giving half that sum. The Newcastle College of Physical Science was established ten years ago by the combined efforts of the townspeople and the University of Durham.

H.R.H. THE PRINCESS LOUISE AND THE BOARD SCHOOLS.—On the 13th July there was a large gathering of Board-school girls for the performance of Swedish exercises at the Beethoven Street School, the Princess Louise, attended by Lady Macnamara and Captain Collins, being present. Among the other spectators were Lady Stanley of Alderley, Lord and Lady Brabazon, Lady Maude Stanley, etc. Mr. E. N. Buxton, Chairman of the Board, presided, and said in an introductory address that the School Board felt, as educationists, that a healthy mind could not have full play without a healthy body, and they had therefore paid attention to the physical training of the children in their schools. The exercises which followed, under the superintendence of Miss Löfving, were watched by the visitors with much interest, and were gone through in an admirable manner. On the motion of Mrs. Garret Anderson, seconded by Miss Davenport Hill, a vote of thanks was given to the Princess for her presence; the Chairman afterwards stating that Her Royal Highness had asked him to say how much pleasure she had felt in seeing the evolutions, and that she was sure they must be very valuable to the children who had the benefit of them. The proceedings then terminated.

THE LONDON SCHOOL BOARD FÊTE AT THE CRYSTAL PALACE.—The Bishop of Manchester distributed the principal prizes of over 4,000 Bibles and Testaments, presented by Mr. F. Peek and the Religious Tract Society, to pupil teachers, candidates, and scholars of the London Board schools, at the Crystal Palace, on Saturday, the 16th July. Among those present were many well-known friends of education. After a few words from Mr. Peek, in which he referred to the deaths of Sir C. Reed and Mr. Rodgers, the Bishop of Manchester distributed the prizes. His Grace said he saw from the report of the examination in Scripture knowledge that for the preliminary examination 141,000 children presented themselves, or within one or two thousand of the whole number of children in ordinary daily attendance in the London Board schools. This indicated that the parents of the children desired them to receive religious instruction, and in the face of that desire no theorist had a right to interpose his crude ideas, and say that the children should be taught only secular knowledge. He hoped the teachers, whether connected or not with any religious denomination, would count it not only their highest duty, but their chief honour and privilege to keep alive in the hearts and intellects of those committed to their charge, the spirit of a simple, reasonable, and apostolic Christianity. Mr. Buxton proposed

a vote of thanks to the Bishop of Manchester, and in the course of his remarks he expressed his concurrence in what had been said by Mr. Peek as to the irreparable loss which the School Board had sustained. The Rev. L. B. White seconded the resolution, which the Bishop briefly acknowledged. During the afternoon 3,000 of the teachers and pupils of the London School Board gave an excellent choral concert. Mr. John Evans was the conductor, and Mr. A. Rhodes the organist.

Gossip.

In another column we give a short account of the recently-held Domestic Economy Congress. Some of the papers were really excellent, and bore ample testimony to the thoroughness with which the authors had done their work.

⁂

But much of the talk in the discussions was otherwise. One lady had the impertinence to recommend teachers to discard the use of jewellery, and volunteered to mention a school where the girls were considered 'excessively superior' through not wearing it. What twaddle! The ladies who preside over our girls' and infants' schools are quite able to dress themselves without advice from benevolent members of the upper ten. Why don't these good-meaning folk try their hand on their æsthetic brethren and sisters? Physician, heal thyself!

⁂

From the theoretical it is a pleasure to turn to the practical. During the past month the energetic lessees of the Alexandra Palace—Messrs. Jones and Barber—have provided for their patrons a 'cooking exhibition.' This interesting collection of foodstuffs and apparatus has been entrusted to the care of Mrs. B. W. Gothard. She at intervals gives short and instructive cookery lectures, making in the presence of her audience several of the tasty dishes she describes. Among the numerous exhibits we noticed Card's meat juice extractor; Fletcher's cooking and boiling stoves; the Anglo-American Tin Stamping Co.'s machines; Rippingill's patent cooking stoves; Hancock's bread-making machines; Topham's patent mincing-machine; and Branson's coffee-machines; *Clayton's Hopetta*, a temperance tonic beverage which, we understand, has received the commendation of the Bishop of Exeter. Among other drinks are to be found *Vin Santé*, *Cowslip wine*, and *Vitality*.

⁂

Just before leaving the building we were advised to pay a visit to 'Little Salvini,' a mere child, who for his age displays exceptional elocutionary ability. He recited 'The Charge of the Light Brigade' and 'The Swimmer' with a grace of action and intensity of feeling that would put to the blush the performance of many of our pupil teachers. We hope to have another opportunity of hearing him.

⁂

Speaking of the one palace reminds us of the other on the crest of Sydenham Hill. Last Saturday (July 16th) was a red-letter day for the metropolitan youngsters who attend the Board schools. All honour to such noble men as Sir Francis Peek, whose liberality will be heard of generations hence.

⁂

At the conclusion of what may be termed the day's serious work, old and young threw off reserve and enjoyed themselves to the full.

⁂

Perhaps the pleasantest sight was to be had from the balcony at the north end of the Palace. Standing here, one could see the many thousands of children dotting the lovely grounds in merry groups, making fun out of everything. It was a fit occasion to have given birth to Mr. N. P. Willis's beautifully touching lines beginning—

> 'I love to look on a scene like this,
> Of wild and careless play,' etc.

⁂

Rumour has it that another change is pending at the Westminster Wesleyan College. The Rev. G. W. Olver, the valued Principal of Southlands, will, it is expected, go to the Mission House in the late Dr. Punshon's place. In that case the Rev. G. O. Bate, the hard-working Westminster Secretary, will naturally look for the Southlands preferment, so his place will become vacant. Three names—all of them *names of ministers*, we are sorry to say—have already been mentioned by the Education Committee as likely to fill the gap. The committee have recently shown excellent judgment in selecting an able layman as their vice-president. We wish they would continue in well-doing. To our knowledge there are at least half a dozen men—men who have given their best days to Methodist education —who could discharge the duties, onerous as they are, as satisfactorily as any minister. And ninety-nine out of every hundred Westminster men would be delighted to learn that one of their *confrères* had been elected to the office, and that the committee were following in the wake of the best colleges.

⁂

Dr. Jowett, whose translation of Thucydides was announced in our last issue, is to be heartily congratulated on the scholarly manner in which he has done his work. His translation—in which he has followed a sound text, that of Poppo—is marked by a beauty and grace of style, and distinguished by a force of language, which makes it the best English version in existence, far surpassing that of Crawley or Dale.

⁂

Professor C. A. Bucheim, of King's College, London, has undertaken to edit for the Clarendon Press an annotated edition of Lessing's *Nathan der Weise*, uniform with the same editor's series of German classics.

⁂

The Lord Mayor gave a banquet at the Mansion House, on the 25th June, to the representatives of Literature. Among the three hundred gentlemen

present were Lords Lytton, Sherbrooke, and Houghton; Mr. Justin McCarthy, M.P., Mr. G. A. Sala, Mr. Kegan Paul, Mr. W. Black, Mr. E. Yates, Mr. W. M. Rossetti, Mr. Julian Hawthorne, Mr. M. Tupper, Rev. J. G. Wood, etc.

⁂

Messrs. Rivingtons' announcements for early issue include the following works:—*A Latin-English Dictionary for Junior Forms*, by C. G. Gepp, late Head Master of King Edward VI. School, Stratford-upon-Avon; *A Short History of England for Schools*, with Maps and Illustrations, by F. York-Powell, Lecturer at Ch. Ch., Oxford; and a new and revised edition of Arnold's *Practical Introduction to Latin Prose Composition*, by the Rev. G. G. Bradley, Master of University College, Oxford.

⁂

Mr. F. J. Furnivall, who has probably paid more attention to the works of our national poet than any living man, has published a little book, entitled *Shakspere and Holy Writ*, to the text of which he has prefixed some admirable Forewords.

⁂

The Greeks are about to erect a marble statue of Lord Byron at Missolonghi, in remembrance of the services which he rendered to their country in the struggle for independence of 1824. Professor Semitelo, of Athens, has written the inscription in hexameters.

⁂

The 'Equitable Life Assurance Society of the United States' announce that they will give a prize of £100 to the author of the best essay on 'Life Assurance.' The judges are Mr. S. C. Hall, F.S.A., Mr. C. Walford, F.S.S., and Mr. T. Hughes, Q.C.

⁂

The council of Owen's College, Manchester, propose to appoint five fellowships in science or literature, each of the value of £100, tenable for one year, but renewable for two years further. The appointment will be made, not on the results of examination, but after consideration of documentary and other evidence. Every holder of a fellowship will be expected to devote his time to the prosecution of some special study approved by the council.

⁂

Dr. Allon, of the *British Quarterly*, has had the good luck to obtain, from a lady in Cheshunt, thirty-five letters written by the late George Eliot, when a young lady, and in a state of mind almost orthodox.

⁂

Dr Schliemann has just returned from a journey of exploration through the Troad. He has been specially examining the Ida mountains, and claims to have discovered the altar of Zeus.

⁂

M. Jules Simon has carried an amendment, by 139 to 126, to the French Government Bill, which excluded all religious teaching in the French primary schools.

Messrs. Griffith and Farran will publish immediately, in their series of wall-sheets for teaching needlework, etc., a new sheet designed by the Senior Examiner of Needlework to the School Board for London.

⁂

Prof. Oliver J. Lodge, who has been for some time Assistant-Professor of Physics at University College, London, has been appointed to the Lyon-Jones Professorship of Experimental Physics and Mathematics in University College, Liverpool.

⁂

The Hakluyt Society has in the press two interesting volumes relating to early travel. The first is a collection of the voyage of Baffin, edited by Mr. Clements R. Markham, C.B., F.R.S.; the other relates to the Portuguese mission of Alvarez to the Prester John, translated and edited by Lord Stanley, of Alderly.

——o——

Publications Received.

Biography—

(1) Beesley's Life of Sir John Franklin. M. Ward & Co.

English History—

(1) Blanchard's Notabilia of English History. T. Murby.
(2) Laurie's Historical Readers. St. II. III. IV. T. Laurie.

Geography—

(1) Blakiston's Glimpses of the Earth. Griffith & Farran.
(2) Geography of Ayrshire. Porteus Bros.
(3) Isbister's Third Geographical Reader. Isbister.
(4) Marshall's Descriptive Geography Reader. I. II. III. John Marshall & Co.

Grammar—

(1) Harry Hawkin's H. Book. Griffith & Farran.
(2) Murby's Imperial Grammar and Analysis. T. Murby.

Gymnastics—

(1) Hartelius' Home Gymnastics. Isbister.

Miscellaneous—

(1) Andrew's Punishments in the Olden Time. Stewart & Co.
(2) Twenty Minutes' Talk with Parents. Isbister.

Periodical Literature—

(1) Ward and Lock's Universal Instructor. IX. Ward & Lock.

Political Economy—

(1) Palgrave's Political Economy Reading Books. National Society.

Poetry—

(1) Fletcher's Songs after Sunset. W. Poole.
(2) Hall's Rhymes in Council. Griffith and Farran.

Science—

(1) Johnson's Botany Reading Books. Part I. National Society.

Theology—

(1) Thomas's Outlines of Paley's Evidences. T. Murby.
(2) Murby's Scripture Manuals. 1st Corinthians. T. Murby.

Matriculation Chemistry.

(*Continued from page* 233.)

BY E. W. V. VOLCKXSOM,

Lecturer on Chemistry at St Gregory's College, Downside, Bath.

31. Calculate the molecular **weights** and **percentage composition** of the salts having the formula $CaSO_4 + 2H_2O$ and $BaCl_2 + 2H_2O$; and give the chemical characters by which they can be identified, and the names of the salts. Jan. 1860.

$CaSO_4 + 2H_2O$ is called calcic sulphate.

$$Ca = 40 \ldots \frac{40 \times 100}{172} = 23{\cdot}26$$

$$S = 32 \ldots \frac{32 \times 100}{172} = 18{\cdot}60$$

$$O_4 = 64 \ldots \frac{64 \times 100}{172} = 37{\cdot}21$$

$$(2H_2O) = 36 \ldots \frac{36 \times 100}{172} = \frac{20{\cdot}93}{100{\cdot}00}$$

Molec. weight = 172

$BaCl_2 + 2H_2O$ is called baric chloride.

$$Ba = 137 \ldots \frac{137 \times 100}{244} = 56{\cdot}15$$

$$Cl_2 = 71 \ldots \frac{71 \times 100}{244} = 29{\cdot}10$$

$$(2H_2O) = 36 \ldots \frac{36 \times 100}{244} = \frac{14{\cdot}75}{100{\cdot}00}$$

Molec weight = 244.

In order to identify these two salts, dissolve both in water; then add to both solutions a few drops of **baric chloride**. A white precipitate is formed in the solution of calcic sulphate, but not in the baric chloride. Then add to the solutions a few drops of **argentic nitrate**. A white precipitate is formed in the solution of baric chloride, but not in that of calcic sulphate.

32. What are the **proportions by weight** of the constituent elements of the following compounds:—Marsh gas, olefiant gas, carbonic acid, and water? *June*, 1869.

Marsh gas (CH_4). The proportions are 12 of carbon and 1 of hydrogen.

Olefiant gas (C_2H_4). Proportions, 24 of carbon and 2 of hydrogen.

Carbonic acid (CO_2). Proportions, 12 of carbon and 32 of oxygen.

Water (H_2O). Proportions, 2 of hydrogen and 16 of oxyen.

32.* What is an **acid**?

Strictly speaking, an **acid** is a body containing *hydrogen* replaceable by a metal, when that metal is presented to it in the form of a hydrate, *e.g.* hydric sulphate (H_2SO_4), hydric chloride (HCl).

When the water (H_2O) has been abstracted, the body often retains the name of an acid; but it is better to prefix the term *anhydrous*, which means *without water*, *e.g.* SO_2; SO_3; N_2O_5.

34.* What is a **base**?

A **base** is a certain compound of a metal with oxygen (as Na_2O; CaO; Fe_2O_3), with hydroxyl (HO), (as KHO; BaH_2O_2; $Fe_2H_6O_6$), or with nitrogen, phosphorus, etc. (as NH_3; PH_3).

35. What are the **distinctive properties** of the two classes, acids and alkaline oxides, or bases? What is the **nature** of a salt? *July*, 1846.

What is the distinction between an **alkali** and an **acid**? What is meant by the term **salt**? *July*, 1860.

The **distinctive properties** of acids and alkaline oxides, or bases, are:—

1st. The first turn blue litmus red, and the latter turn red litmus blue.

2d. They combine to form *salts*, generally with the elimination of water.

A **salt** may therefore be defined as *an acid in which the hydrogen has been partly or wholly replaced by a metal.* If the hydrogen has been only partly removed, the salt is said to be *acid;* if wholly, it is said to be *neutral.* If more base is present than is necessary to neutralize the acid, the salt is said to be *basic.*

36. What is meant by the expression of the **neutralization** of an acid by an alkali? What is the **result** of such neutralization? *July*, 1844.

It means that the acid and the alkali have both lost their characteristic properties, that is to say, that they are without action upon litmus paper.* The result of such neutralization is a **neutral salt**.

37. What class of bodies do we call **oxides**? Name some oxides of an **acid nature** and some **basic** oxides. *June*, 1867.

Oxides are a class of bodies resulting from the combination of oxygen with other elements.

Oxides of an **acid** nature are,—nitric acid, N_2O_5; sulphurous dioxide, SO_2; sulphuric trioxide, SO_3, etc.

Oxides of a **basic** nature are,—potassic oxide, K_2O; sodic oxide, Na_2O; calcic oxide, CaO, etc.

38. Two oxides are given to you, one **an acid**, the other **a base**. Explain how you would determine which of the two is the acid. *June*, 1874,

The term acid is, I presume, used here to mean an *anhydride*. First, then, I would add water to both, and afterwards I would dip into both vessels a strip of blue litmus paper. The vessel in which the blue

* This is not always true. Some chemically neutral salts are acid, some basic to litmus; some chemically acid salts are basic to litmus, and *vice versâ*.

litmus turns red contains the **acid** and the other the **base.**

39. Two liquids are given, one containing **an acid** and the other **a base.** Describe the experiments you would perform in order to ascertain which of the two liquids contains the **acid.** *Jan.* 1868.

Define the characters by which **oxides** and **acids** are discriminated. *Jan.* 1860.

1st. The action of turning blue litmus paper red is characteristic of **acids,** and not of **bases.**

2d. The **acid** poured over a carbonate, whether the carbonate be in solution or not, causes a great effervescence, which would not be caused by an **oxide.**

40. Describe experiments by which you would endeavour to ascertain whether a given substance (dissolved in water) is **an acid, a base,** or **a salt.** Give an example of a body belonging to each of the above-named classes; and enumerate those properties of each body which you consider to afford the best proof that it belongs to the class to which you assign it. *June,* 1866.

1st. Example of **an acid**—hydric sulphate, H_2SO_4.
2d. " **a base**—potassic oxide, K_2O.
3d. " **a salt**—potassic sulphate, K_2SO_4.

Blue litmus paper dipped in the first solution would become red, and would again become blue if dipped in the second. If dipped in the third solution, it would remain unaffected.

41. What is meant by a **hydrate**? Exemplify the difference between water of composition and water of crystallization. *July,* 1863.

Oxides combined with water form hydrates (KHO, NaHO). The water there combined is called *water of hydration.*

Some salts contain water chemically combined as essential to their constitution (CaH_2SO_5; CaH_4SO_6). This is called *water of composition.*

Other salts contain water which is not necessary to their composition, but only to their crystalline form ($KAlS_2O_8 + 12H_2O$ = alum). This water is called *water of crystallization.*

Water of crystallization is driven off by a temperature of about 100° C., which is not the case with water of composition.

42. Indicate the distinctive characters of **alkalies, alkaline earths,** and **earths,** appending a tabular list of the different species under each class. *Jan.* 1860.

The **alkalies*** are soft, easily fusible, volatile at higher temperature, combine very energetically with oxygen, decompose water at all temperatures, and form strong basic oxides very soluble in water.

The **alkaline earths** are similar to the alkaline metals, except that they are less soluble in water.

The **earths** are not soluble at all in water.

Tabular List.

Alkali metals.	Alkaline earths.	Earths.
H_3N	BaH_2O_2 or BaO	Al_2O_3
KHO	SrH_2O_2 or SrO	
NaHO	CaH_2O_2 or CaO	
LiHO		

43. Explain the nature of **oxidation** and the nomenclature of the oxides. *July,* 1857

When metals and certain other bodies are placed in the presence of oxygen, they combine, forming a class of salts called **oxides.** This takes place in the case of some, such as potassium and sodium, by exposure to the air at ordinary temperatures; in the case of others, as zinc, iron, and lead, when moisture is present or when heated; with others, as in the case of antimony and mercury, under the influence of heat. Most metallic oxides are reduced by hydrogen and by carbon.

To designate the **oxides,** it is best to give first the metal or the non-metal, followed by the word *oxide.* If it is required to express the exact number of atoms of oxygen present, the word **oxide** has the syllables *mono, di* or *bi, tri* or *ter, tetra, penta* prefixed. Some oxides are *acid,* and are termed *anhydrides;* others are *neutral;* and again others are *basic.*

44. How are **elements** and **compounds** denoted by symbols and chemical formulæ? *July,* 1849.

The **elements** are denoted by the first or first and second letters of their name. In a few cases the initial of the Latin name is taken. Thus H, O, Na, K stand for hydrogen, oxygen, sodium (Natrium), and potassium (kalium).

Compounds are denoted by the symbols of their component elements; and if there be present more than one atom of any component element, a small figure indicating the number of atoms present is placed below to the right of the symbol of that element. Thus H_2SO_4 is the chemical formula for hydric sulphate, and denotes that there are present 2 atoms of hydrogen, 1 of sulphur, and 4 of oxygen.

45. Write in **symbols** the following compounds:—Water, sulphuric acid, nitric acid, nitrous oxide, sulphuretted hydrogen. *Jan.* 1865.

Water, H_2O; sulphuric acid, H_2SO_4; nitric acid, HNO_3; nitrous oxide, N_2O; sulphuretted hydrogen, H_2S.

46. Explain fully the **meaning** of the following symbols:—O_2, H_2, Cl_2, Br_2, I_2, C, N_3, S, P, CO_2, SO_3H_2O, and NH_3. *June,* 1866.

O_2 means a molecule or two atoms of free oxygen.

H_2 means a molecule or two atoms of free hydrogen.

* The *oxides* and *hydrates* are the alkalies, etc. The *metals* in them are termed metals of the alkalies, alkaline earths, and earths.

Cl_2 means a molecule or two atoms of free chlorine.
Br_2 means a molecule or two atoms of free bromine.
I_2 means a molecule or two atoms of free iodine.
C means one atom of free carbon.
N_2 means a molecule or two atoms of free nitrogen.
S means one atom of free sulphur.
P means one atom of free phosphorus.
CO_2 means one molecule of carbonic dioxide (carbonic acid).
SO_3H_2O (H_2SO_4) means one molecule of hydric sulphate (sulphuric acid).
NH_3 means one molecule of trihydric nitride (ammonia.)

47 Give the **chemical formulæ** for common salt, saltpetre, iron, and copper. *July*, 1857.

Common salt, NaCl; saltpetre, KNO_3; iron, Fe; copper, Cu.

48. Give the **chemical symbols** and **formulæ** for gold, silver, lead, nitrate of silver, nitrate of baryta, caustic soda. *July*, 1858.

Gold, Au; silver, Ag; lead, Pb; nitrate of silver, $AgNO_3$; nitrate of baryta, $Ba2(NO_3)$ or BaN_2O_6; caustic soda, NaHO.

49. Give the **composition** and systematic **designation** of each of the following salts:—Common salt, alum, green vitriol or copperas, gypsum, nitre, limestone, and fluor spar. *July*, 1855.

Common salt, sodic chloride, NaCl.
Alum, aluminic potassic sulphate, $AlK(SO_4)_2 + 12H_2O$.
Green vitriol, ferrous sulphate, $FeSO_4 + 7H_2O$.
Gypsum, calcic sulphate, $CaSO_4 + 2H_2O$.
Nitre, potassic nitrate, KNO_3.
Limestone, calcic carbonate, $CaCO_3$.
Fluor spar, calcic fluoride, CaF_2.
The composition of each salt is sufficiently expressed through its formula.

50. Give the **formula** of the following substances:—Water, ammonia, silica, carbonic acid, sulphuric acid, marsh gas, and phosphuretted hydrogen. *Jan*. 1869.

Water, H_2O; ammonia, H_3N; silica, SiO_2; carbonic acid, CO_2; sulphuric acid, H_2SO_4; marsh gas, CH_4; phosphuretted hydrogen, PH_3.

51. Give the **symbols** of the following elements and compounds:—Hydrogen, nitrogen, nitrous acid, carbon, marsh gas, chlorine, bromine, phosphorus, phosphoric acid, and silicic acid. *June*, 1867.

Hydrogen = H, nitrogen = N, nitrous acid = N_2O_3, carbon = C, marsh gas = CH_4, chlorine = Cl, bromine = Br, phosphorus = P, phosphoric acid = H_3PO_4 or P_2O_5, silicic acid = SiO_2.

52. Give the **atomic constitution** and **formulæ** of alum, sulphate of magnesia, sulphate of soda, and calomel. *July*, 1856.

Alum, $AlK(SO_4)_2 + 12H_2O$, is constituted of 1 atom of aluminium, 1 of potassium, 2 of sulphur and 8 of oxygen, crystallized with 12 molecules of water of crystallization.

Sulphate of magnesia, $MgSO_4 + 7H_2O$, is constituted of 1 atom of magnesium, 1 of sulphur, and 4 of oxygen, crystallized with 7 molecules of water of crystallization.

Sulphate of soda, $Na_2SO_4 + 10H_2O$, is constituted of 2 atoms of sodium, 1 of sulphur, and 4 of oxygen, crystallized with 10 molecules of water of crystallization.

Calomel, mercurous chloride, Hg_2Cl_2, is constituted of 2 atoms of mercury and 2 atoms of chlorine.

53. Give the **chemical names** of the salts having the formulæ KCl and Na_2OCO_2, and detail the means by which they can be **discriminated**. *July*, 1859.

KCl = potassic chloride, and Na_2OCO_2 (or Na_2CO_3) = sodic carbonate or disodic carbonate.

If any acid, say **sulphuric acid**, be poured into a solution of a carbonate, an effervescence takes place, and the carbonic acid is expelled, causing lime-water to become turbid. This does not take place with potassic chloride so treated.

On the other hand, add to the solution of potassic chloride a few drops of **hydric nitrate** and **argentic nitrate**. A white precipitate of argentic chloride is formed, which result is not seen if sodic carbonate be treated in like manner.

54. Give the **formulæ** of the following substances:—Water, ammonia, silica, carbonic acid, sulphuric acid, marsh gas, and phosphuretted hydrogen. *Jan*. 1869.

Water = H_2O, ammonia = NH_3, silica = SiO_2, carbonic acid = CO_2, sulphuric acid = H_2SO_4, marsh gas = CH_4, phosphuretted hydrogen = PH_3.

55. Give the **formulæ** of potassic nitrate and potassic nitrite. *June*, 1880.

Potassic nitrate has for formula KNO_3, potassic nitrite KNO_2.

56. What is meant by the term **crystal?** Describe some of the processes by which crystals may be formed. *July*, 1860.

A **crystal** is the regular geometrical form which certain solid bodies assume when placed in favourable circumstances, the form being bounded by planes, which are inclined at angles to one another under certain laws.

(To be continued.)

Pupil Teacher's Examination Questions.

JUNE, 1881.

CANDIDATES.

Three hours and a half allowed for this paper.

Arithmetic.

MALES.

1. If a bankrupt pays 3s. 4d. in the £1, what sum will be received on a debt of £7357 12s. 0d.?

2. 1200 hands in a factory are paid at an average rate of 1s. 8½d. per working day. To what sum does the total of their wages amount in a fortnight? and in a year (312 working days)?

3. If a tradesman with a capital of £2000 gains £90 in 3½ months, in what time may he expect to gain £20 5s. 0d. with a capital of £315?

4. If each of the hundred pages of a book is to contain 34 lines of print, with an average of 11½ words in each line and 4 letters in each word, what will be the cost of printing the book at the rate of ¼d. per 16 letters?

5. Find the cost of laying down a room 21 feet long by 16 broad with carpet 2 feet in width at 5s. a yard, the cost of the labour being charged at 3½d. per yard extra for each yard of carpet.

FEMALES.

1. A person gives a £5 note to pay the following bill:—

				s.	d.	
3½ cwt.	of	coal	at	0	10½	a cwt.
13 lbs.	,,	cheese	,,	0	7¾	a lb.
2¾ ,,	,,	tea	,,	3	3	,,
17 ,,	,,	sugar	,,	0	5½	,,
8½ yds.	,,	flannel	,,	1	11½	,,
29 ,,	,,	calico	,,	0	10¾	,,

What change should he receive?

2. £28 4s. is divided amongst eighteen men and a certain number of women; each man has £1 3s. 6d., and each woman 15s. 8d. Find the number of women.

3. A person bought 8 ac. 1 ro. 6 po. at £56 an acre, and 18 ac. 2 ro. 33 po. at £52 an acre; the cost of the timber was £60 in addition. Find the amount of the whole purchase.

4. Find the value of 6043 lbs. of tea at 3s. 2½d. a lb. (by Practice).

Grammar.

1. Parse all the verbs and adverbs in the following passage:—

'Full knee-deep lies the winter snow,
And the winter winds are wearily sighing;
Toll ye the church-bell, sad and slow,
And tread softly, and speak low,
For the old year lies a-dying.'—TENNYSON.

2. Give three examples of numerals which are adjectives, and three others of numerals which are nouns, and show how you distinguish between them.

Geography.

1. What names are given to projecting points of land? Give an example of the use of each name in Great Britain or Ireland, and describe the situation and appearance of each.

2. '*The Tay, like the Yorkshire Ouse, is fed by many affluents, each flowing in a valley of its own, and all in a general easterly or south-easterly direction.*'

Explain this sentence, name the affluents, and trace the course of each.

If you can, draw a map of the basin of the Tay.

3. Name, in order, the chief railways by which a traveller can leave London, describe the direction of each, and trace a journey by *one* of them to some large town.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inflexibility*.

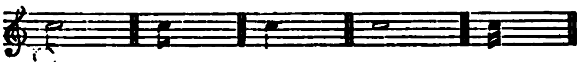
Write, in small hand, as a specimen of copy-setting, '*Ah, thus King Henry throws away his crutch.*'

Music.

A quarter of an hour allowed for this paper.

1. Write over each of the following notes its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other).

2. Follow each of these notes by its corresponding rest.



3. How many tones and semitones are found in a major scale, and what are the places of the latter?

ANSWERS.—CANDIDATES.

Arithmetic.

MALES.

1. By paying 3s. 4d. in the £1, only ⅙th of the debt will be received, and ⅙th of £7357 12s. = £1226 5s. 4d.

2.

	£	s.	
	1200	0	
1s. 8d. = $\frac{1}{12}$ of £1	100	0	
½d. = $\frac{1}{40}$ of 1s. 8d	2	10	
£	102	10	= wages of 1200 men every day.

There are 12 working days in the fortnight,
∴ £102 10s. × 12 = £1230. 1st Ans.
There are 26 fortnights in the year of 312 days,
∴ £1230 × 26 = £31,980. 2nd Ans.

3. £315 : £2000 :: 3½ mos.
£90 : £20 5s.

$$\tfrac{7}{2}\text{ mos.} \times \frac{2000 \times 405}{315 \times 1800} = 5\text{ mos. Ans.}$$

4. 34 × 11½ = 391 words,
391 × 4 = 1564 letters.
16 : 1564 :: ¼d.
¼d. × $\frac{1564}{16}$ = $\frac{1564}{64}$d. = 24$\frac{7}{16}$d. = 2s. 0$\frac{7}{16}$d. Ans.

5. 21 ft. × 16 ft. = 336 sq. ft. = content of carpet.
$\frac{236}{2}$ sq. ft. = 118 ft. = 39⅓ yds. of carpet required.
39⅓ yds. at a total cost of 5s. 3½d. each.

	£	s.	d.		s.	d.
	39	6	8			
5s. 0d. = ¼ of £1	9	16	8	= cost of 39⅓ yds. at	5	0
3 = $\frac{1}{20}$ of 5s.		9	10	= ,, ,, ,,		3
½ = ⅙ of 3d.		1	7⅔	= ,, ,, ,,		½
£	10	8	1⅔	= ,, ,,	5	3½

FEMALES.

1.

			s.	d.		£	s.	d.
3½	cwt.	at	0	10½	=	0	3	0¾
13	lbs.	,,	0	7¾	=	0	8	4¾
2¾	lbs.	,,	3	3	=	0	8	11¼
17	lbs.	,,	0	5½	=	0	7	9½
8½	yds.	,,	1	11½	=	0	16	7¾
29	yds.	,,	0	10¾	=	1	5	11¾
						3	10	9¾

£5 − £3 10s. 9¾d. = 1 9 2¼ change received.

2.
£1 3s. 6d. × 18 = £21 3s. sum received by the 18 men.
£28 4s. − £21 3s. = £7 1s. ,, ,, ,, women.
Every woman receives 15s. 8d.
∴ 15s. 8d. × No. of women = £7 1s.

or $\frac{£7\ 1s.}{15s.\ 8d.}$ = No. of women.

$\frac{1692d.}{188}$ = 9 women. Ans.

3.

	£	s.		
	56	0		
		8		
	448	0	=	value of 8 ac. at £56 per ac.
1 ro. = ¼ ac.	14	0	=	„ 1 ro. „ „
5 po. = ⅛ ro.	1	15	=	„ 5 po. „ „
1 po. = ⅕ of 5 po.		7	=	„ 1 po. „ „
£	464	2	=	„ 8 ac. 1 ro. 6 po.

	£	s.	d.		
	52	0	0		
			18		
	936	0	0	=	value of 18 ac. at £52 per ac.
2 ro. = ½ ac.	26	0	0	=	„ 2 ro. „ „
20 po. = ¼ of 2 ro.	6	10	0	=	„ 20 po. „ „
10 po. = ½ of 20 po.	3	5	0	=	„ 10 po. „ „
2 po. = ⅕ of 10 po.		13	0	=	„ 2 po. „ „
1 po. = ½ of 2 po.		6	6	=	„ 1 po. „ „
£	972	14	6	=	„ 18 ac. 2 ro. 33 po.

ac.	ro.	po.		£	s.	d.
8	1	6	cost	464	2	0
18	2	33	„	972	14	6
The timber			„	60	0	0
Total			„	1496	16	6 Ans.

4.

	£	s.	d.		
	6043	0	0		
2s. = $\frac{1}{10}$ of £1	604	6	0	=	value of 6043 at 2s. each.
1s. = ½ of 2s.	302	3	0	=	„ „ 1s. „
2d. = ⅙ of 1s.	50	7	2	=	„ „ 2d. „
½d. = ¼ of 2d.	12	11	9½	=	„ „ ½d. „
£	969	7	11½	=	„ „ 3s. 2½d.

Grammar.

1. *full*—adv. modifying *knee-deep.*
   knee-deep—adv. (with somewhat of an adjective meaning) modifying intrans. verb *lies.*
   lies—intrans. verb, strong conj. (*lie, lay, lain*), indic. mood, pres. indef. tense, 3rd pers. sing. ag. with its subj. *snow.*
   are sighing—progressive form of the intrans. regular verb, indic. mood, pres. indef. tense, 3rd pers. plur. agreeing with subj. *winds.*
   wearily—adv. of manner modif. *are sighing.*
   toll—trans. verb, weak conj., imper. mood., 2nd pers. plur. agreeing with subj. *ye.*
   sad—adv. (adj. form) modif. *toll.*
   slow—adv. (adj. form) modif. *toll.*
   tread—intrans. verb, strong (irreg.) conj. (*tread, trod, trodden*) imper. mood, 2nd pers. plur. agr. with subj. *ye.*
   softly—adv. modif. *tread.*
   speak—intrans. verb, strong (irreg.) conj. (*speak, spoke, spoken*), imper. mood, 2nd pers. plur. agr. with *ye.*
   low—adv. (adj. form), modif. *speak.*
   lies—same as before, but agrees with subj. *year.*
   a-dying—adv. modif. *lies.*
2. Numerals are nouns when they take a plural form or take *a* before them.

Adjectives.	*Nouns.*
One boy.	I have seen many a *one.*
Fifty men.	We saw them in *hundreds.*
Three or *four* men.	How many *twos* in six?

Geography.

1. The names given to projecting points of land in Great Britain and Ireland are:—

Cape—Cape Wrath, north-western extremity of Caithness, a lofty pyramidal rock.
Head—Duncansbay Head, north-eastern extremity of Caithness.
Mull—Mull of Cantire, south of Argyleshire, a narrow peninsula 50 miles long.
Ness—Buchan Ness, in Aberdeenshire, a rocky headland 33 feet above the sea.
Point—Ardnamurchan Point, most westerly part of the mainland of Britain, the end of a long tongue of land.
Butt—Butt of Lewis, a tapering point, the extremity of the island.
Foreland—North and South Foreland, the termination of the Downs.
End—Land's End, an abrupt mass of granite rock in the south-west of Cornwall.
Bill—Portland Bill, south of Dorset, a long spur of rocks striking out westwards.
Ord—Ord of Caithness, rises on the east of the county from the shore with a sharp ascent of 700 feet.
Peculiar { *Nase*—The Naze, in the east of Essex.
Needles—The Needles, eastern point of the Isle of Wight. }

2. The meaning of the sentence is that the tributaries of the Tay are numerous and that each one. gives name to the valley through which it flows.

LIST OF AFFLUENTS.

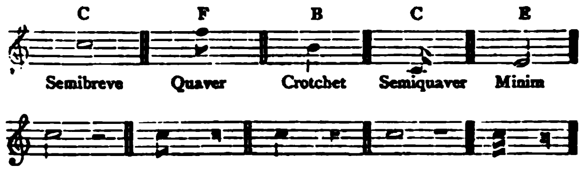
The Lyon	flowing E.	through	Glen Lyon,
The Tummel	„ E.	„	Glen Rannoch, joins
The Garry	„ S.E.	„	Glen Garry,
The Bran	„ E.	„	Strath Bran,
The Almond	„ E.	„	Glen Almond,
The Earn	„ E.	„	Strath Earn, and
The Isla	„ S. & W.	„	Glen Isla.

3. The railways by which a traveller can leave London are:—

Great Eastern	going towards the		Eastern Counties.
Great Northern	„	„	„ Berwick.
Midland	„	„	„ Midland Cos. and Carlisle.
North-Western	„	„	Carlisle and Holyhead.
Gt. Western and S. Wales	„	„	Penzance and Milford Haven.
South-Western	„	„	S.W. to Exeter.
South-Eastern	„	,	S.E. to Dover and Canterbury.

In journeying by the latter we pass *Croydon*, noted for its races; *Reigate*, noted for mineral springs; *Tunbridge*, famous wells; *Folkestone*, a seaport, and reach *Dover*.

Music.



Five tones and two semitones, the latter being placed between the third and fourth, and seventh and eighth notes of the scale.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Add together $\frac{1\frac{1}{3}}{2\frac{1}{4}}$ of 4s. 7d.; 2·35 of 1s. 0d.; and ·2375 of £1; and reduce the result to the decimal of 7s. 6d.
2. If 1·75 shares in a mine cost £11·25, what will 14·375 shares cost?
3. What sum is the same fraction of half-a-crown that 2s. 9⅜d. is of half-a-guinea?
4. I am offered one guinea, *or* $\left\{\frac{7\frac{1}{2}}{6\frac{1}{4}}+\left(\frac{11\frac{1}{2}-2\frac{3}{5}}{11\frac{1}{2}+2\frac{3}{5}}\times 10\frac{2}{13}\right)-7\frac{1}{8}\right\}$ of £1 for an article. Which is the better offer,—and by how much?
5. How many 'francs' must be transmitted from Paris to Berlin to pay a debt of 420 'thalers,' assuming a franc to be worth £·0416, and a thaler £·15?

FEMALES.

1. If 27 men can perform a piece of work in 15 days, how many men must be added to the number, that the work may be finished in three-fifths of the time?

2. The first, third, and fourth terms of a proportion are 3 cwt. 14 lbs.; £1 7s. 1d., and £5 1s. 10d. respectively. Find the second term.

3. If the wages of 13 men, for $7\frac{1}{2}$ days, amount to £13 7s. $0\frac{1}{2}$d., how many men ought to work for 4 weeks for £173 8s.?

4. If 20 men, 40 women, and 50 children receive £350 for 7 weeks' work, and 2 men receive as much as 3 women or 5 children, what sum can a woman earn a week?

Grammar.

1. Parse the prepositions and pronouns in the following:—

'So move we on—I only meant
To show the reed on which you leant,
Deeming the path you might pursue,
Without a pass from Roderick Dhu.'—SCOTT.

2. Make two sentences with *who* and *which* as interrogatives, and two with *who* and *which* as relative pronouns.

3. When does a preposition show the relation between an object and an action? Give examples.

Geography.

Answer either Q. 1 or Q. 3, not both.

1. Name, in order, the chief railways by which a traveller can leave London, describe the direction of each, and trace a journey by *one* of them to some large town.

2. Draw a map showing the courses of the Spanish rivers which flow into the Mediterranean Sea.

3. Say what you know about Bavaria, Baden, Bohemia, Hungary, Servia, Poland, and Lithuania.

History.

1. Write out a list of our sovereigns from William I. to Edward I., with dates.

2. What sovereigns filled the English throne during the fourteenth century?

3. Make out a list of the sovereigns from Queen Mary to Queen Anne, and show the relationship between them.

Penmanship.

Write in large hand, as a specimen of copy-setting, the word *Inflexibility*.

Write in small hand, as a specimen of copy-setting, '*Ah, thus King Henry throws away his crutch.*'

Composition.

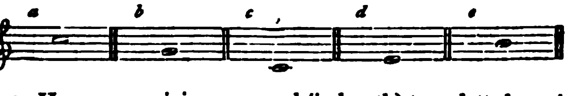
Write from memory the substance of the passage read to you by the Inspector.

Music.

A quarter of an hour allowed for this paper.

1. Write in *a* the scale of *A* (*La*), and in *b* the scale of E♭ (*Me*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

2. Place its third over *a*, its fifth over *b*, its fourth over *c*, its second over *d*, and its seventh over *e*.



3. How many minims are equal (in length) to a dotted semibreve?

How many quavers are equal (in length) to a minim?

How many semiquavers are equal (in length) to a dotted crotchet?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. $\frac{1\frac{1}{2}}{2\frac{1}{4}}$ of 4s. 7d. $= \frac{2}{3}$ of $4\frac{7}{12}$s. $= 3\cdot0\dot{5}$ s.

$$\begin{aligned} 1\text{s.} \times 2\cdot35 &= 2\cdot35 \\ 20\text{s.} \times \cdot2375 &= 4\cdot75 \\ &\overline{10\cdot1\dot{5}} \end{aligned}$$

and $10\cdot1\dot{5}$s. to the dec. of 7s. 6d. $= \frac{10\cdot1\dot{5}}{7\cdot5} = \underline{1\cdot35407.}$ Ans.

2.
$$\begin{aligned} 1\cdot75 &= 1\tfrac{3}{4} = \tfrac{7}{4} \\ 14\cdot375 &= 14\tfrac{3}{8} = \tfrac{115}{8} \\ £11\cdot25 &= 11\tfrac{1}{4} = \tfrac{45}{4} \end{aligned}$$
$$\tfrac{7}{4} : \tfrac{115}{8} :: £\tfrac{45}{4} = £\tfrac{45}{4} \times \frac{4 \times 115}{7 \times 8} = \underline{£92\ 8\text{s.}\ 2\tfrac{4}{7}\text{d.}}$$

3.
$$\frac{2\text{s. } 9\frac{3}{5}\text{d.}}{10\text{s. } 6\text{d.}} = \frac{33\frac{3}{5}}{126} = \frac{168}{630} = \frac{4}{15}$$
and $\frac{4}{15}$ of 30d. = 8d. Ans.

4.
$$\left\{\frac{7\frac{1}{2}}{6\frac{1}{2}} + \left(\frac{11\frac{1}{2} - 2\frac{2}{5}}{11\frac{1}{2} + 2\frac{2}{5}} \times 10\tfrac{9}{13}\right) - 7\tfrac{1}{8}\right\}$$
$$= \left\{\tfrac{15}{13} + \left(\frac{115 - 24}{115 + 24} \times \tfrac{139}{13}\right) - 7\tfrac{1}{8}\right\}$$
$$= \left(1\tfrac{2}{13} + \frac{91 \times 139}{139 \times 13} - 7\tfrac{1}{8}\right)$$
$$= (1\tfrac{2}{13} + 7 - 7\tfrac{1}{8})$$
$$= (8\tfrac{16}{104} - 7\tfrac{13}{104}) = 1\tfrac{3}{104} \text{ of } £1;$$
but 1 guinea $= £1\frac{1}{20}$ or $£1\frac{26}{520}$
and $£1\frac{3}{104} = £1\frac{15}{520}$
∴ the offer of 1 guinea is better by $£\frac{11}{520}$ or $5\frac{1}{13}$d.

5.
£·0416 : £·15 :: 420 thalers : (francs)
or 10d. : 36d. :: 420
$$\frac{420 \times 36}{10} = 1512 \text{ francs. Ans.}$$

FEMALES.

1.
$\frac{3}{5}$ths of 15 days = 9 days,
and 9 days : 15 days :: 27 men : 45 men
45 − 27 = 18 men. Ans.

2.
1st term × 4th term = 2nd term × 3rd term,
or Product of *extremes* = product of *means*.
3 cwt. 14 lbs. : ? :: £1 7s. 1d. : £5 1s. 10d.
or 350 lbs. × $\frac{1222}{325}$d. = 1316 lbs. = 11 cwt. 84 lbs.

3.
£13 7 $0\frac{1}{2}$d. : £173 8s. :: 13 men
or or
6409 half-d. : 83,232 half-d.
24 das. : $7\frac{1}{2}$ days.
$$\frac{13 \text{ men} \times 29 \times 83232}{96 \times 6409} = \frac{357}{7} = 51 \text{ men.}$$

4.
2 men = 3 women = 5 children
∴ 20 ,, = 30 ,, = 50 ,,
Now since 20 men = 30 women
and 50 children = 30 ,,
so 40 women more
are = 100 ,,
∴ £350 ÷ 100 = £3 10s. sum received by a woman in 7 wks.
or £3 10s. ÷ 7 = 10s. per wk. Ans.

Grammar.

1. *We*—1st personal pron., mas. gender, plur., nom., subj. of *move*.

I—1st. pers. pron., mas., sing., nom., subj. of *meant*.

on—preposition gov. obj. case *which*.

which—simple rel. pron., neut., referring to *read*, sing., obj. gov. by *on*.

you—2nd pers. pron., masc., plur. (form), nom., subj. of *leant*.

you—same as above, subj. of *might pursue*.

without—prep. gov. obj. case *pass*.

from—prep. gov. obj. case *Roderick Dhu*.

2. Interrogatives:—*Who are you? Which shall I take?*
Relatives:—*The boy who is here. The book which you read.*

3. A preposition shows the relation between an object and an action when the phrase extends the meaning of a verb, as—Place the book *on the table*: the *on* here shows the relation between *table* and the *act of placing*.

Geography.

1. *See same question answered under Candidates in this number of Magazine.*

3. *Bavaria* is one of the South German States, its principal towns are *Munich*, with fine buildings and art collections; *Ratisbon*, with the famous 'Walhalla'; *Nuremberg*, with great clock-making; and *Speyer* or *Spires*, where the Reformers presented their *protest* to the Diet.

Baden is a Grand-Duchy in the S.W. of Germany, lying along the right bank of the Rhine. It is mountainous and its scenery is very beautiful. Its chief towns are *Carlsruhe*, built like a fan; *Heidelberg*, with famous wine-vat; *Baden-Baden*, with mineral springs; and *Constance* on L. Constance, where John Huss and Jerome of Prague were condemned to be burnt.

Bohemia, a province of Austria-Hungary, very fertile and rich in mineral products, famed also for the manufactures of glass and linen. Its chief towns are *Prague* and *Königrätz*, the former a noble and antique city, the latter near the field of *Sadowa*, where the Austrians were defeated July, 1866.

Hungary, a country of Central Europe, forming part of the Austrian empire. The Carpathian Mountains form its northern boundary. It is watered by the Danube and its large tributary the Theiss. The population are mostly Magyars, and the chief towns are *Buda-Pesth*, the capital; *Presburg*, seat of the Hungarian Diet; and *Tokay*, noted for sweet wines.

Servia, a country of Europe separated from Austria-Hungary by the Save and the Danube. The Drave forms its western boundary, and it has Turkey on the east and south. It was tributary to Turkey till liberated by the Treaty of Berlin (1878). Its capital is *Belgrade*.

Poland, once an independent kingdom, is now the westerly portion of European Russia. In 1795, Russia, Prussia, and Austria divided the country among themselves. *Warsaw* and *Lublin* are the chief towns.

Lithuania, was a large tract of country in the North of Europe, now forming part of Western Russia, and includes a portion of the Kingdom of Poland. Its ancient capital was *Vilna*.

History.

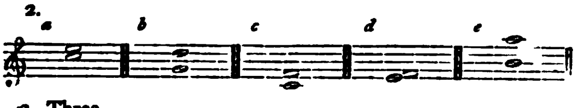
			A.D.
1.	William I. began to reign		1066
	William II.	,,	1087
	Henry I.	,,	1100
	Stephen	,,	1135
	Henry II.	,,	1154
	Richard I.	,,	1189
	John	,,	1199
	Henry III.	,,	1216
	Edward I.	,,	1272
2.	Edward I.	,,	
	Edward II.	,,	1307
	Edward III.	,,	1327
	Richard II.	,,	1377
	Henry IV.	,,	1399

3. Elizabeth was the sister of her predecessor Mary.
James I. was the great-grandson of Elizabeth's aunt, Margaret Tudor.
Charles I. was the son of James I.
Charles II. and
James II. were the sons of Charles I.
William III. was the nephew, and
Mary II. was the daughter, of James II.
Anne was the sister of Mary.

Music.

1.

2.



3. Three.
Four.
Six.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the interest and amount of £225 in 4 years at $1\frac{3}{4}$ per cent. per annum simple interest.

2. If in a shipwreck 68 passengers only are lost out of 340, what percentage of passengers are saved?

3. What does a huckster receive in cash who buys 150 eggs at $6\frac{1}{2}$d. a dozen, and sells them at a profit of 4d. per score; and what percentage does he get on his outlay?

4. Find the yearly income arising from the investment of £4788 in $3\frac{1}{2}$ per cent. stock at 105.

5. Divide 1860 guineas among A., B., and C., in such a way that as often as A. gets £5, B. shall get £4; and as often as B. gets £3, C. shall get £1.

FEMALES.

1. Simplify :—$2\frac{2}{3}$ of $2\frac{4}{7}$ of $\frac{2}{11} \times 1\frac{7}{15}$ of $26\frac{1}{4} \div 21\frac{3}{8}$.

2. What number must be subtracted from $560\frac{5}{8}$ to leave a remainder equal to the sum of $126\frac{1}{7}$ and $240\frac{3}{4}$?

3. If 30 horses eat $25\frac{3}{5}$ bus. of oats in 6 days, how much will one horse eat in a week?

4. Reduce $\dfrac{3\frac{1}{6}}{1\frac{1}{15}}$ of $\left\{\frac{13}{16} \text{ of } £1 - \frac{7}{48} \text{ of 1s.}\right\}$, to the fraction of a moidore (a moidore = 27s.).

Grammar.

1. 'O must we then
Risk new found happiness again,
Trust fate of arms once more?
And is there not a simple glen
Where we, content and poor,
Might build a cottage in the shade?'—SCOTT.

(*a*) Is the word 'where,' in the above passage, an adverb or a conjunction? Give a reason for your answer.

(*b*) How are the verbs 'risk,' 'trust,' 'build,' in the above, to be parsed, if taken without the auxiliary?

(*c*) Point out the subordinate sentence in the above, and analyse it.

2. Distinguish between a phrase and a sentence. Is it quite correct to say that a sentence may be the subject of a sentence?

Geography.

Answer *either* Q. 1 *or* Q. 3, *not both*.

1. Say what you know about Bavaria, Baden, Bohemia, Hungary, Servia, Poland, and Lithuania.

2. Draw a full map of Southern India and Ceylon; *not* including the basins of the Ganges and the Indus.

3. What do you know about the history of British North America?

One hour allowed for Females, two hours and a half for Males.

History.

1. Give some account of the reigns of Ethelbert and Oswald.

2. What part was taken by Edward I. in the disturbances created by the barons in his father's reign? How would you explain his conduct?

3. What was the Great Charter? From its provisions show what were the chief abuses of Government under the Plantagenets?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inflexibility*.

Write, in small hand, as a specimen of copy-setting, '*Ah, thus King Henry throws away his crutch.*'

Composition.

Write full notes of a lesson on *Palm-trees*.

Euclid.

[All generally understood abbreviations for *words* may be used, but no symbols of *operation*, such as −, +, ×, are admissible.]

1. Upon the same base, and on the same side of it, there cannot be two triangles that have their sides which are terminated in one extremity of the base, equal to one another, and likewise those which are terminated in the other extremity.

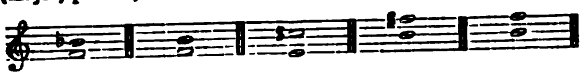
2. If one side of a triangle be produced, the exterior angle is greater than either of the interior opposite angles.

Any two exterior angles of a triangle are together greater than two right angles.

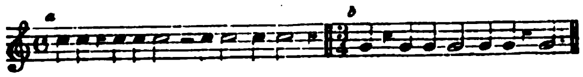
Music.

A quarter of an hour allowed for this paper.

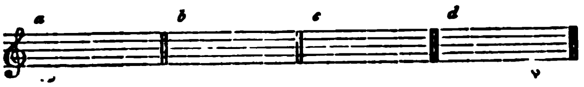
1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms.



2. Divide (by bars) the notes in *a* into measures of common time; those in *b* into measures of triple.



3. Write in *a* the signature of A (*La*), in *b* that of G (*Sol*), in *c* that of F (*Fa*), and in *d* that of E♭ (*Me*).



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. $\frac{£225 \times 4 \times 1\frac{3}{4}}{100} = £15\ 15s.$ Interest Ans.

$£225 + £15\ 15s. = £240\ 15s.$ Amt. Ans.

2. $\frac{63}{315} = \frac{1}{5}$ the fraction of whole lost and $\frac{1}{5}$ of 100 = 20 per centage lost. Ans.

3. 150 eggs at $6\frac{1}{2}$d. per doz. = 6s. $9\frac{1}{4}$d.

A profit of 4d. per score = 4d. × $7\frac{1}{2}$. = 2s. 6d.

Total sum received = 9s. $3\frac{1}{4}$d. Ans.

and he gains $\frac{2s.\ 6d. \times 100}{6s.\ 9\frac{1}{4}d.}$ p. c. or $36\frac{12}{13}$. Ans.

4. $\frac{£3\frac{1}{2} \times 4788}{105} = \frac{£7 \times 4788}{210} = £\frac{4788}{30} = £159\ 12s.$ Ans.

5. When A gets £5
B „ 4
and C „ $1\frac{1}{3}$
$10\frac{1}{3}$ parts.

$10\frac{1}{3} : 5$ :: 1860 gui. : 900 gui. A's share.
$10\frac{1}{3} : 4$ :: 1860 „ : 720 „ B's „
$10\frac{1}{3} : 1\frac{1}{3}$ :: 1860 „ : 240 „ C's „

FEMALES.

1. $\frac{12}{5} \times \frac{18}{7} \times \frac{2}{11} \times \frac{22}{15} \times \frac{105}{4} \times \frac{5}{108}$
after cancelling the expression = 2. Ans.

2. $560\frac{5}{8} - (126\frac{1}{7} + 240\frac{3}{4}) = 560\frac{35}{56} - (126\frac{8}{56} + 240\frac{42}{56})$
$= 560\frac{35}{56} - 366\frac{50}{56} = 193\frac{41}{56}$. Ans.

3. 30 horses : 1 horse :: $25\frac{5}{7}$ bush.
6 da. : 7 da.

$\frac{180}{7}$ bush. × $\frac{1 \times 7}{30 \times 6}$ = 1 bush.

4. $\frac{28}{9} \times \frac{13}{14}$ of $\frac{912 - 7}{48}$s. to the fraction of 27s.

$\frac{905}{48}$s. × $\frac{26}{9} \div 27 = \frac{905 \times 26}{48 \times 9 \times 27} = \frac{11765}{5832}$. Ans.

Grammar.

1 (*a*). *Where* is a *relative* or *conjunctive adverb* modifying *might build*, like an adverb of place, as well as connecting the subordinate sentence with the principal. *Where* is equal to *and there*.

(*b*) *risk*, *trust*, and *build* parsed singly are *infinitives*.

(*c*) The subordinate sentence is, '*Where we, content and poor, might build a cottage in the shade.*'

Connective.	Subject.	Enlargements of Subject.	Predicate.	Object.	Extension of Predicate.
Where	we	content and poor	might build	a cottage	in the shade.

2. A *phrase* consists of two or more words grammatically connected but not making complete sense, but a *sentence* always makes the sense complete; thus, 'Hearing a noise, he ran for a gun,' is a sentence, but *hearing a noise* and *for a gun* are phrases. A sentence may be the subject of a complex sentence; thus, '*I must persevere*,' was the student's motto, where *I must persevere* is the subject of *was*.

Geography.

1. *See same question under 'First Year' in this number of the Magazine.*

3. The coasts of N. America were discovered by Cabot, a native of Bristol, in 1497, and in 1588 the French began to colonize the country in the vicinity of the St. Lawrence. The Pilgrim Fathers, in 1620, founded the New England States, between whom and the French great rivalry existed for a long time. As often as war broke out between the mother countries it extended to the Colonies. By the treaty of Utrecht (1713), Nova Scotia and Newfoundland were ceded to Britain. At length the French, seeking to obstruct British progress towards the West, caused a struggle between the two nations, which struggle resulted in the complete conquest of Canada by Wolfe, on the Plains of Abraham (1760). When in 1783, by the acknowledgment of the Independence of the States, a number of loyal colonists left for British soil, they settled in what was afterwards Upper Canada, and many thousands removed to New Brunswick. The British North American Colonies continued to be governed separately by representative assemblies till 1867, when the Dominion of Canada was constituted by the union of Quebec, Ontario, Nova Scotia, and New Brunswick. Hudson Bay Territory was added in 1870, British Columbia in 1871, and Prince Edward Island in 1873.

SECOND PAPER.

History.

1. *Ethelbert*, King of Kent (597), influenced by his wife Bertha, was the first royal convert to Christianity, as preached by Augustine. The chief church was built at Canterbury, of which Augustine was made Archbishop. *Oswald*, of Northumbria, had, while exiled among the Scots, been taught the Christian doctrines in Iona. On his return he founded a monastery in Lindisfarne (Holy Isle).

2. During the absence of Henry III. in France, whither he had gone for the purpose of getting Louis to mediate between him and his rebellious subjects, the dissensions between the two parties of the Committee appointed after the Mad Parliament grew so great that a civil war seemed inevitable. Prince Edward prepared to take a part by levying troops, and roused the king's suspicion. The prince cleared himself by taking a solemn oath that he did not mean treason. However, when Henry, encouraged by the support of the Earl of Gloucester, revoked all his concessions, Edward pleading the obligation of his oath, sided with the barons for the time. But when Leicester declared that the Committee of Government should exercise its authority even during the reign of Henry's successor, Edward lost all scruples about keeping his oath, and denounced the barons as traitors and usurpers, openly declaring against them and all their statutes. It is not easy to account for his conduct unless we may suppose that he was led on with the hope of usurping the crown, his father being weak and faithless, and likely to be deposed. He may have sided with the barons to avoid perjuring himself, or on the other hand to discover their real intentions respecting the limits of the king's power.

3. The Great Charter was a document signed by King John at Runnymede (1215). The Charter was no novelty nor did it claim to establish any new constitutional principles, but the vague expressions of the older charters were now exchanged for precise and elaborate provisions. From its provisions we learn that the chief abuses of government were the lawless exactions of John and his predecessors. They had increased the amount of scutage and restored the land-tax, seized the church property, imposed aids, fines, and ransoms at pleasure, without the counsel of the barons, abused the rights of wardship, compelled widows to marry for the crown profit, influenced judges, and confiscated the freeman's property.

Composition.

NOTES ON PALM-TREES.

Appearance.—Tall, straight trunk—often rising to a height of fifty feet—leaves spring from top of stem with a graceful bend—resemble ostrich feathers—tuft of green leaves on top retains its freshness all the year—fruit grows in clusters under the leaves.

Where they grow.—As they require both moisture and heat, they grow in tropical countries—chiefly in tropical parts of South America, in North Africa, Ceylon, East India, Islands of South Pacific.

Species.—Nearly 500 known species—most familiar are cocoa-nut palm, date palm, sago palm, wax palm, wine palm.

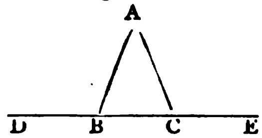
Uses.—Cocoa-nut yields food from kernel—drink from milk—'arrack,' made from palm wine—fibres of husk made into cables and matting—oil from kernel—palm oil from Africa used for oiling carriage-wheels.

Dates supply people of North Africa, of Arabia, and Persia with food. *Sago* is the pith of a kind of palm in East Indies—wax is drawn from another species by cutting leaves and trunk. Wine, oil, wax, flour, sugar, even salt produced from palm tribe—and fibre affords material for habitations, vessels, weapons, and clothing.

Euclid.

1. Prop. 7, Bk. I.
2. Prop. 16, Bk. I.

Rider.—Produce BC both ways to E and D. Then (by Prop. 17) the angles ABC, ACB, are together *less* than *two* right angles. But the four angles ABD, ABC, ACB, ACE (I. 13) are together equal to *four* right angles, and therefore the exterior angles ABD, ACE, must be *greater* than *two* right angles.



Music.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May,* **1878; and Pupil Teachers at end of Fourth Year, if apprenticed before that date.**

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What *percentage* respectively of the £ sterling is each of the following:—10s., 5s., 2s. 6d., 2s., 1s., 6d., 4d., 3d., 1d., ½d., and ¼d.?

2. If a tradesman, instead of a true lb. weight, uses one which weighs only 15·75 oz., what percentage does he gain by his dishonesty, and what is his total gain in money, on selling £6 11s. 3d. worth of goods?

3. What is meant by 'discounting a bill'? What does a banker gain by discounting on July 1st, a bill of £150 dated May 22nd, at 3 months, at $4\frac{1}{2}$ per cent.?

4. At what rate per cent. per annum, simple interest, will £1873 6s. 8d. amount to £2314 14s. 9d., in $4\frac{7}{8}$ years?

5. In a class of 25 children, 19 had been in attendance during the week. The children attended 5 for 5 days, 6 for $4\frac{1}{2}$ days, 3 for 4 days, 2 for $3\frac{1}{2}$ days, 1 for 3 days, 1 for 2 days, 1 for $\frac{1}{2}$ a day. Find *average* number of days attended by each child.

FEMALES.

1. Reduce to decimals—
   (*a*) $\frac{11}{10000}$.
   (*b*) $15\frac{2476}{15875}$.
   (*c*) $\frac{6\frac{3}{4}}{11\frac{1}{4}}$

2. Find the greatest common measure and also the least common multiple of 49·383 and ·142569.

3. If forty men can reap 400·6 acres in 12·75 days, how many acres ought 30 men to reap in 3·4 days?

4. How many oranges at £·084375 a dozen ought to be given for 378 eggs at ·0625s. each?

Grammar.

1. Point out and analyse the adjective and adverbial sentences in the following passage, and give your reasons for calling them so:—

> 'As *one that* museth *where* broad sunshine laves
> The lawn by some cathedral, thro' the door
> *Hearing* the holy organ *rolling* waves
> Of sound on roof and floor
> *Within*, and *anthem sung*, is charmed and tied
> *To where* he stands,—*so* stood I.' TENNYSON.

(*a*) Parse the words in italics.
(*b*) Write out the sense of the passage in your own words.

2. Mention any names of parts of speech which are compounded of Latin prepositions, and show the force of the preposition in each case.

3. Show that what is called an object in a sentence is strictly a complement to the predicate. Distinguish between a direct and an indirect object.

Geography.

Answer *either Q. 2 or Q. 3, not both.*

1. Draw a full map of Southern India, and Ceylon, *not* including the basins of the Ganges and the Indus.
2. Give notes of a lesson on 'Deserts,' with illustrations from Asia and Africa.
3. What do you know about the history of the British settlements in Africa?

SECOND PAPER.

One hour allowed for Females, two hours and a half for Males.

History.

1. What measures were taken by Henry VII. to increase and establish the King's power?
2. What was the Pilgrimage of Grace? Mention some sources of discontent which led to it, and describe its suppression.
3. Describe the chief events of Monmouth's rebellion in England and Scotland.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inflexibility.*

Write, in small hand, as a specimen of copy-setting, '*Ah, thus King Henry throws away his crutch.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operations*, such as −, +, ×, are not admissible.]

1. If a straight line falling on two other straight lines, make the alternate angles equal to each other; these two straight lines shall be parallel.

2. The complements of the parallelograms, which are about the diameter of any parallelogram, are equal to one another.

3. Through a given point A draw a line, so that the perpendiculars upon it from two other given points B, C, may be equal to each other.

[Bisect the line BC in D, join AD, etc.]

Algebra.

1. Simplify $3(a-2x)^2+2(a-2x)(a+2x)+(3x-a)(3x+a)-(2a-3x)^2$, and write down the square root of the result.
2. Find the G.C.M. of x^3-8x+3 and x^4+3x^3+x+3.
3. Solve the equations:—

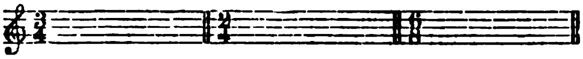
$$(1.)\ x-1-2(2x-9)=\frac{2x}{5}$$

$$(2.)\ \frac{ax-b^2}{a-b}-\frac{bx-a^2}{a+b}=\frac{ab}{b-a}$$

Music.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of F♯ (*Fe*). Mark the places of the semitones.

2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures.



3. Write over each of the following the name of the major scale, and under each that of the minor scale, of which it is the signature.

ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. 20s. : 100s. :: 10s. : 50 p. c.
or 10s. = £½ and as 100 represents £1
∴ 10s. = 50 p. c. of £1.

Similarly

5s. = £¼ or 25 p. c.	4d. = £1/60 or 1⅔ p. c.
2s. 6d. = £⅛ ,, 12½ ,,	3d. = £1/80 ,, 1¼ ,,
2s. 0d. = £1/10 ,, 10 ,,	1d. = £1/240 ,, 5/12 ,,
1s. 6d. = £3/40 ,, 7½ ,,	½d. = £1/480 ,, 5/24 ,,

¼d. = £1/960 or 5/48 p. c.

2. By selling 15·75 oz. in place of 16 oz. he gains ·25 oz. on every 15·75, *i.e.*, $\frac{\cdot 25}{15\cdot 75}$ or $\frac{1}{63}$ of the whole.

(*a*) $\frac{1}{63}$ of £6 11s. 3d. = $\frac{131\text{s. } 3\text{d.}}{63}$ = 2s. 1d. Ans.

(*b*) The gain p. c. = $\frac{100}{63}$ = $1\frac{37}{63}$. Ans.

3. (*a*) *Discounting a bill.*—If the holder of a bill desires to be paid before the bill is due, he usually takes it to a banker or 'bill discounter,' who calculates the interest at so much per cent. per ann. on the full debt for the length of time the bill has to run, and deducts the interest. In making this deduction and in paying the balance the banker is said to *discount the bill.*

(*b*) The bill was discounted July 1st, and was not due till August 25th (including 3 days of grace)
∴ No. of days for which interest or discount must be allowed = 30 in July + 25 in Aug. = 55

Hence Banker's charge $= £4\frac{3}{4}\times\frac{150}{100}\times\frac{55}{365}$
$= £\frac{19\times150\times5}{4\times100\times365}$
$= £\frac{19\times3\times11}{4\times2\times73}$
$= £\frac{627}{584}$
i.e., £1 1s. $5\frac{49}{73}$d.

True discount on £150 for 55 days at 4¾ p. c. is calculated as follows:—

Interest of £100 for 55 days $= £4\frac{3}{4}\times\frac{55}{365} = £\frac{19\times11}{4\times73}$
i.e., $£\frac{209}{292}$

∴ True discount on $£100\frac{209}{292} = £\frac{209}{292}$

,, ,, $£150 = £\frac{209}{292}\times\frac{150}{100\frac{209}{292}}$
$= £\frac{209\times150}{29409}$
i.e., $£\frac{10450}{9803}$ = £1 1s. $3\frac{8235}{9803}$d.

	£	s.	d.
(1) Banker's discount =	1	1	$5\frac{49}{73} = \frac{480347}{715619}$
(2) True ,, =	1	1	$3\frac{8235}{9803} = \frac{601155}{715619}$
diff. in favour of (1) =			$1\frac{594811}{715619}$d. Ans.

4.

	£	s.	d.
Amount =	2314	14	9
Principal =	1873	6	8
∴ Interest =	441	8	1

∴ Rate per cent. $= £441\ 8\text{s. } 1\text{d.}\times\frac{100}{1873\frac{1}{3}}\times\frac{1}{4\frac{7}{8}}$
$= £441\ 8\text{s. } 1\text{d.}\times\frac{300}{5620}\times\frac{8}{39}$
$= £\frac{105941}{240}\times\frac{5}{281}\times\frac{8}{13}$
$= £4\frac{5}{6}$.

5.
5 × 5 = 25 days
6 × 4½ = 27 ,,
3 × 4 = 12 ,,
2 × 3½ = 7 ,,
1 × 3 = 3 ,,
1 × 2 = 2 ,,
1 × ½ = ½ ,,
19)76·5
4·02... Ans.

FEMALES.

1. (*a*) $\frac{11}{16000} = \frac{\cdot 011}{4\times4} = \frac{\cdot 00275}{4} = \cdot 0006875$. Ans.

(*b*) $15\frac{3476}{15625} = 15\frac{3476\times8}{15625\times8} = 15\frac{27808\times8}{125000\times8} = 15\frac{222464}{1000000}$
= 15·222464. Ans.

(*c*) $\frac{6\frac{3}{4}}{11\frac{1}{4}} = \frac{27}{45} = \frac{3}{5} = \cdot 6$. Ans.

2. To simplify the work, multiply each number by 1,000,000, and divide G.C.M. when found by 1,000,000.

2	142569	493830000	346
	108252	427707	
1	34317	661230	
	19809	570276	
2	14508	909540	
	10602	855414	
	3906	54126	1
	2790	34317	
4	1116	19809	1
	1116	14508	
		5301	1
		3906	
		1395	1
		1116	
		279	= G.C.M. 1,000,000 times too much

∴ ·000279 = true G.C.M.

$$\text{L.C.M.} = \frac{49\cdot383\times\cdot142569}{\cdot000279} = 49\cdot383\times511 = 25{,}234\cdot713.$$

3. 40 men : 30 men :: 400·6 acres
12·75 da. : 3·4 da.
400·6 ac. × $\frac{30}{40}$ × $\frac{340}{1275}$ = 400·6 ac. × $\frac{3}{4}$ × $\frac{4}{15}$
= $\frac{400\cdot6}{5}$ ac. = 80·12 ac. = 80 ac. 19·2 po.

4. £·084375 = 1·6875s. = 20¼d.
1 doz. eggs cost ·0625s. × 12 = ·75s. = 9d.
20¼d. : 9d. :: 378 : No. of oranges
378 × $\frac{36}{81}$ = 378 × $\frac{4}{9}$ = 168. Ans.

Grammar.

Sentences.	Kind.	Subject and Enlargement.	Predicate.	Object.
(*a*) As one thro' the door hearing the holy organ rolling waves of sound on roof and floor within and anthem sung is charmed.	adverbial of manner	(as) one hearing thro' the door the holy organ rolling waves of sound on roof and floor within and anthem sung	is charmed	
(*b*) As one, etc., *same as* (*a*) is tied to where he stands	adv. of manner	*same as* (*a*)	is tied to where he stands	
(*c*) that museth	adjective	that	museth	
(*d*) Where broad sunshine laves the lawn by some cathedral	adverbial of place to (*c*)	(where) broad sunshine	laves	the lawn by some cathedral
(*e*) where he stands	adject. to (place)	(where) he	stands	

(*a*) *one*—indef. pron., 3rd pers. sing., mas., nom. to *is charmed.*
that—simple rela. pron. referring to *one*, 3rd pers. sing., nom. to *museth.*
where—rel. adv. modifying *laves* and connecting '*the sunshine laves, etc.*,' with *that museth.*
hearing—incomplete part of the reg. verb *hear* qualifying *one.*
rolling—incomplete part of the reg. verb *roll* qual. *organ.*
within—adverb modifying *rolling.*
anthem—abstr. noun, neu. sing., obj. gov. by *hearing.*
sung—complete part of irreg. verb *sing, sang, sung,* qual. *anthem.*
to—prep. gov. obj. case (*place*) or the phrase *where he stands.*
where—rel. adverb introducing subordinate sent. *he stands.*

(*b*) I was rooted to the spot like a person who, while meditating in the grounds near some cathedral, bathed in a sea of glorious light, listens in rapture to the sacred music of voice and instrument, echoing and re-echoing within the holy edifice, and finally issuing with re-doubled harmony in floods through the open door.

2. *adjective* is compounded with *ad.* 'to,' and means *thrown to* (a noun).
pronoun is compounded with *pro*, 'for' or 'instead of,' *i.e.*, *instead of* (a noun).
adverb—*ad.* 'to' *to a word, i.e.*, to a verb, adjective, or other adverb.
preposition—*pre* 'before'—*placed before* (a noun).
conjunction—*con* (for *cum*) 'with,' 'together,' *joining* (words or sentences) *together.*
interjection—*inter* 'between,' 'among'—*thrown among* (the words without any connection).

3. When the predicate verb is transitive it always has an object, and this object is really part of the predicate, the meaning of which it completes, as, The man struck *the dog.* Without the object, *dog*, the meaning of *struck* would be incomplete. In the sentence, 'Bring me a grammar'—*grammar* is called the *direct* object, and *me* the *indirect* or *dative* object, as it is governed by *to*, understood. The *indirect* object is also governed by *for.*

Geography.

2. *Appearance.*—Covered with hot shining sand which hurts the eyes and burns the feet—no water—hot winds arise, called 'sirocco' and 'simoom'—travellers throw themselves on the ground till the storms pass—fertile spots here and there, called 'oases,' having water, green grass, and palm-trees.

How crossed.—Camel, called 'ship of the desert'—peculiarly adapted for long journeys from the formation of stomach and the hump of fat on its back—can close its eyes and nostrils against the 'hot wind'—travellers form a caravan for protection against robbers—water carried from oasis to oasis in skins.

Illustrations.—(1) Great sandy desert of *Gobi* or *Shamo* of Central Asia—comprises a considerable part of Turkestan and Mongolia—length from E. to W. about 1,500 mls., breadth from 500 to 700 mls.—abounds in salt—signs of having once been covered with ocean. (2) *Arabia* is almost all desert—having vast sandy plains surrounding its elevated interior—diversified only by a few spots of fertility. (3) Interior of Northern Africa characterized by great sterility; in this region is the *Sahara* or *Great Desert*—a vast elevated gravelly tract studded with immense belts of arid sand ridges—with now and then beautiful oases—the whole region being without rain or dew, and uninhabitable; beds of marine shells have lately been discovered—hence believed to have been once covered by the sea.

3. Cape Colony was taken by the British in 1806, up to which year it belonged to the Dutch, who had planted a colony there in 1652. It was confirmed to this country at the treaty in 1814, and has made great progress under British protection. British Kaffraria, formerly a separate Colony, was incorporated with it in 1866. Basutoland was annexed in 1868-71. In 1871 West Griqualand, north of the Orange River, famous for its diamond fields, was ceded to Britain, and a constitution was framed for it in 1873. Natal was made a separate colony in 1856. The Transvaal was annexed to the British territory in 1848. The Boers lately rebelled, and after holding their own against the British, peace was made and they now acknowledge the suzerainty of the British Crown. Mauritius was taken from the French in 1810. Ascension was occupied in 1815, and St. Helena, after being occupied by the Dutch, was taken by Britain, 1651.

History.

1. To increase and establish the king's power, Henry VII. aimed at humbling the power of the nobles and amassing wealth. He felt that the king could never have any real power so long as the feudal lords kept the kingdom in a constant broil. For the purpose of weakening the power of the nobility he made a law to allow them to alienate their estates, and gradually these were split into numerous inferior tenements. By amassing hoards of money he was independent of his commons, and not subservient to them for supplies. The Star Chamber was instituted by him for the purpose of trying crown officers and offences against the government. He also endeavoured to strengthen his position by foreign marriages, one of which resulted in the 'Union of the Crowns,' namely, the marriage of his daughter Margaret with James IV. of Scotland.

2. The Pilgrimage of Grace was a rebellion of the people of Yorkshire in the reign of Henry VIII. They demanded a reunion with Rome, the restoration of Catherine's daughter Mary to her rights as heiress of the Crown, redress for the wrongs done to the Church by the abolition of the monasteries, and above all the dismissal of Cromwell, whom they hated as an upstart and the usurper of Wolsey's power. By the promise of a pardon and a free parliament at York, the leaders at once flung aside the badge of rebellion. No sooner had they dispersed than the veil was taken off and arrest followed arrest—the country being covered with gibbets, and whole districts handed over to military execution.

3. Four months after the accession of James II., the Duke of Monmouth left the Low Countries, where he had taken refuge after the plot of 1683 and with about eighty followers landed at Lyme. Calling the people to arms, he caused himself to be proclaimed King at Taunton, 1685. On the field at Sedgemoor his miserable army was completely routed by the royal troops. He fled early in the battle, and was captured a few days afterwards. He entreated James to spare his life, but without avail. He was beheaded about ten days after the battle, and his followers were cruelly treated by the brutal Judge Jeffreys, whose circuit at that time has been called the *Bloody Assize.* More than three hundred perished, and crowds suffered mutilation, imprisonment, or exile. In Scotland, Argyle landed in Monmouth's favour in Cantire and summoned his countrymen.

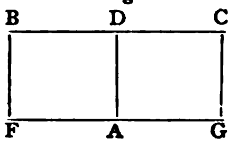
Scarcely two thousand joined him, and with these he marched towards Glasgow, but at Dumbarton his little army was scattered and he himself taken. A few days later he was beheaded at Edinburgh.

Euclid.

1. Prop. 26, Bk. I.

2. Prop. 43, Bk. I.

3. Join BC, bisect BC in D, join AD, and through the point A in the straight line DA draw FAG parallel to BC. FAG is



the straight line required. For if from B and C respectively BF, CG, be let fall perpendicularly on FAG, then the figure BCGF is a parallelogram, and as the opposite sides of such a figure are equal to one another, CG must be equal to BF. —Q.E.F.

Algebra.

1.
$$\begin{array}{rcl} 3(a-2x)^2=3(a^2+4x^2-4ax) & = & 3a^2-12ax+12x^2 \\ 2(a-2x)(a+2x)=2(a^2-4x^2) & = & 2a^2 \qquad\quad -8x^2 \\ (3x-a)(3x+a)=9x^2-a^2 & = & -a^2 \qquad\quad +9x^2 \\ -(2a-3x)^2=-(4a^2+9x^2-12ax) & = & \underline{-4a^2+12ax-9x^2} \\ & & \qquad\qquad\quad +4x^2 \end{array}$$

and the square root of $4x^2=2x$. Ans.

2.
$$x^3-8x+3=(x+3)(x^2-3x+1)$$
$$x^6+3x^5+x+3=x^5(x+3)+(x+3)=(x+3)(x^5+1)$$
$$\therefore\ x+3=\text{G.C.M.}\quad \text{Ans.}$$

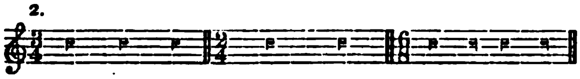
3. (1)
$$x-1-2(2x-9)=\frac{2x}{5}$$
$$5x-5-20x+90=2x$$
$$5x-20x-2x=5-90$$
$$17x=85$$
$$x=5.\quad \text{Ans.}$$

(2) or
$$\frac{ax-b^2}{a-b}-\frac{bx-a^2}{a+b}=\frac{-ab}{a-b}$$
$$(ax-b^2)(a+b)-(bx-a^2)(a-b)=-ab(a+b)$$
$$a^2x-ab^2+abx-b^3-abx+a^3+b^2x-a^2b=-a^2b-ab^2$$
$$a^2x+abx-abx+b^2x=ab^2-ab^2+b^3+a^2b-a^2b-a^3$$
$$a^2x+b^2x=b^3-a^3$$
$$x=\frac{b^3-a^3}{b^2+a^2}$$

Music.

1.

2.



3.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May, 1878*; **and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Sold goods for £225 10s. 0d., and gained thereby $12\frac{1}{2}$ per cent., how much per cent. would have been gained or lost by selling the same goods for £187 10s. 0d.?

2. How long will a loan of £321 15s. $4\frac{1}{2}$d. take to produce £25 5s. $5\frac{1}{1}\frac{9}{1}\frac{1}{0}$d. at $1\frac{1}{2}$ per cent. per annum, simple interest?

3. Find the difference between the selling prices of 14 cwt. 3 qrs. 21 lbs. of coffee bought at £6 10s. 8d. per cwt., if sold (1) at a profit of 5d. per lb., and (2) at a profit of 40 per cent. on cost price.

4. Compare three hundred and ninety-seven thousand one hundred and ninety-six farthings, with the present value of £500 12s. 6d. due in seven years at 3 per cent. per annum.

5. I am offered a salary of £50 a year, along with (*a*) an increase of 30s. per quarter, or (*b*) an increase of £30 a year. Compare my total receipts at the end of 3 and of 4 years respectively, under the two arrangements.

FEMALES.

1. What sum of money, put out at 10 per cent., will produce £12 10s. for interest in 10 days?

2. The sum of two numbers is $9\frac{2}{3}$, and their difference is $4\frac{2}{3}$. Find the ratio of the numbers.

3. If $\frac{3}{4}$ yd. of ribbon cost $3\frac{1}{2}$d., what will be the cost of $6\frac{1}{2}$ pieces, each containing $185\frac{1}{4}$ ells?

4. If a certain quantity of provisions will serve 1,800 men for 12 weeks, at the rate of 15 oz. a day for each man, how many men would three-fourths of the same stock of provisions maintain for 20 weeks at the rate of 8 oz. a day for each man?

Grammar.

1. 'Soe have I allso heard it often wished *that* all *that* land were a sea-poole: *which* kind of speech is the manner rather of desperat men farr driven, to wish the utter ruine of *that* they cannot redress, than of grave counsellors, *which* ought to think nothing soe hard, but *that*, through wysedome, it may be mastered and subdued.'—*View of the present state of Ireland.*

By EDM. SPENSER. 16th Century.

(*a*) Write out the meaning of the above in the language and spelling of the present day.

(*b*) Parse the words *that* and *which* as often as they occur in the above passage.

(*c*) How many sentences are there in the above, and of what kinds? Analyse the first and last.

Geography.

Answer *two* questions; Q. 1 and Q. 2, *if you can.*

1. Draw a full map of British North America, and say what you know about its history.

2. What are trade winds and monsoons? In which of the oceans are they felt? If you can, explain the causes of them.

3. Name the chief groups of islands in the Pacific Ocean, and describe their position.

SECOND PAPER.

One hour allowed for Females, two hours and a half for Males.

History.

1. Compare Edward III. and Henry V. as generals in war and as statesmen in peace.

2. What were the relations of Charles II. to the King of France?

3. What circumstances led to the revolt of the American colonies?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inflexibility.*

Write, in small hand, as a specimen of copy-setting, '*Ah, thus King Henry throws away his crutch.*'

Composition.

Write a short essay on *The House of Commons.*

Euclid.

[The only abbreviations admitted for 'the square on AB' is 'sq. on AB,' and for 'the rectangle contained by AB and CD,' 'rect. AB, CD.']

1. If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by the parts.

2. To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts, shall be equal to the square on the other part.

3. If the diagonals of a quadrilateral are at right angles, the sum of the squares on two opposite sides is equal to the sum of the squares on the two other opposite sides.

Algebra.

1. Find the fraction which becomes 1 when 3 is added to the numerator, and $\frac{1}{3}$ when 2 is added to the denominator.

2. Find (by inspection if you can) the G. C. M. of $3x^2 - 5ax + 2a^2$ and $2x^2 - 5ax + 3a^2$;

and take $\frac{2x - 5a}{2x^2 - 5ax + 3a^2}$ from $\frac{5x - 2a}{3x^2 - 5ax + 2a^2}$

3. Solve the equations:—

(1.) $\begin{cases} 23x - 21y = 16. \\ 24x - 22y = 14. \end{cases}$

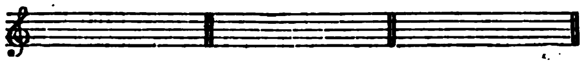
(2) $\frac{2x}{4} + \frac{2x-5}{x-3} = 8\frac{1}{4}$

Mensuration.

In a rectangular court 79 feet by 39 feet, there is a circular basin 7 feet in radius, and four rectangular grass plots, each $20\frac{1}{2}$ feet by $8\frac{1}{4}$ feet. Find the cost of paving the remaining part of the court at $6\frac{3}{4}$d. per sq. yd.

Music.

1. Write the upper tetrachord of G (*Sol*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.



2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms.

3. Write the following, at the same pitch, on the treble stave.

ANSWERS.—FOURTH YEAR.

1. £225·5 : £187·5 :: £112·75.

$£112·75 \times \frac{187·5}{225·5} = £93\frac{3}{4}$, showing a loss of $6\frac{1}{4}$ p. c. Ans.

2. £321 15s. $4\frac{1}{2}$d. : £100 0s. 0d. :: 1 yr.
£1 12s. 6d. : £25 5s. $5\frac{1081}{1200}$d.

After reduction of terms, the work is 1 yr. × [illegible] × [illegible] = 1 yr. × $\frac{1}{3}$ × $\frac{29}{2}$ = $4\frac{5}{6}$ yrs. Ans.

3. $\frac{£6 \text{ 10s. 8d.}}{112}$ = 1s. 2d., the cost price of 1 lb.

∴ 1s. 7d. = selling price of 1 lb., with profit of 5d.

and 1s. 2d. × $\frac{140}{100}$ = 1s. 7·6d. = selling price of 1 lb., with profit of 40 p. c.

·6d. = diff. of selling prices per lb.

14 cwt. 3 qrs. 21 lbs. = 1673 lbs.
·6d. × 1673 = 1003·8d. = £4 3s. 7·8d. Ans.

4. (*a*) Interest of £100 for 7 yrs. at 3 p. c. = £21
∴ Present value of £121 due in 7 yrs. = £100
" " $£500\frac{5}{8}$ " $= £100 \times \frac{500\frac{5}{8}}{121}$
$= £100 \times \frac{4005}{968}$
i.e., £413 14s. $9\frac{63}{121}$d.

(*b*) 397196 farthings = £413 14s. 11d.

Difference in favour of (*b*) $1\frac{58}{121}$d.

5. (1) Calculation for 3 years.
Last payment by (*a*) = $£12\frac{1}{2} + £1\frac{1}{2} \times 11 = £29$
Total sum " = $(£12\frac{1}{2} + £29)\frac{12}{2} = £249$
Total sum by (*b*) = £50 + 80 + 110 = £240

Difference in favour of (*a*) ... £9. Ans.

(2) Calculation for 4 years.
Last payment by (*a*) = $£12\frac{1}{2} + £1\frac{1}{2} \times 15 = £35$
Total sum " = $(£12\frac{1}{2} + £35)\frac{16}{2} = £380$
Total sum by (*b*) = £50 + 80 + 110 + 140 = £380
At the end of 4 years the total sums are equal.

FEMALES.

1. £10 : $£12\frac{1}{2}$ :: £100.
10 das. : 365 das.

$£100 \times \frac{12\frac{1}{2}}{10} \times \frac{365}{10} = £\frac{9125}{2} = £4562$ 10s. Ans.

2. $\frac{9\frac{5}{8} + 4\frac{5}{8}}{2} = 7\frac{1}{8}$ the greater

$\frac{9\frac{5}{8} - 4\frac{5}{8}}{2} = 2\frac{1}{2}$ the less.

(1) $7\frac{1}{8}$: $2\frac{1}{2}$ or 57 : 20 = ratio of greater to the less. In fractional form the ratio is $\frac{57}{20}$.

Ratio of less to the greater = 20 : 57 or $\frac{20}{57}$.

3. $185\frac{1}{2}$ ells × $6\frac{1}{2}$ × $\frac{5}{4}$ = $\frac{371 \times 13 \times 5}{2 \times 2 \times 4}$ = $\frac{24115}{16}$ yds.
$\frac{2}{9}$ yds. : $\frac{24115}{16}$ yds. :: $\frac{7}{2}$d.
= $\frac{7}{2}$d. × $\frac{24115}{16}$ × $\frac{9}{2}$ = $\frac{1519245}{64}$
= £98 18s. $2\frac{13}{64}$d.

4. 20 wks. : 12 wks. :: 1800 men
8 oz. : 15 oz.
4 parts : 3 parts.
1800 men × $\frac{12}{20}$ × $\frac{15}{8}$ × $\frac{3}{4}$ = $\frac{6075}{4}$ =
Ans. $1518\frac{3}{4}$ men ($\frac{3}{4}$ = part of food required for one man).

Grammar.

1. (*a*) I have frequently heard people express a wish that Ireland was sunk in the sea, but to desire the destruction of what one cannot mend is more characteristic of people in a state of despair than of serious thinking men, who should consider nothing too difficult for a wise prudence to conquer and improve.

(*b*) *that*—conjunction connecting subordinate sent. with the principal.
that—demonstr. adj. qual. *land.*
which—distinguishing adj. qual. *kind.*
that—(= what) demonstrative pron., sing., neut., obj. by *of.*
which—(= who) simple rel. pron., plur., mas., referring to *counsellors*, nom. to *ought.*
that—final conj. introducing subordinate sent. '*it may be mastred.*'

(*c*) (1) 'Soe have I allso heard it often wished.' (*Principal sentence.*)
(2) 'That all that land were a sea-poole.' (*Subordinate noun sentence.*)
(3) 'Which kind of speach is the manner of desperat men farr driven to wish the utter ruine of that rather than of grave counsellors.' (*Principal sentence.*)
(4) 'Which ought to think nothing soe hard.' (*Subordinate adjective sentence.*)
(5) 'But that through wysedom it may be mastred.' (*Subordinate adverbial sentence.*)
(6) ('But that, through wysedom it may be) subdued.' (*Subordinate adverbial sentence.*)

	Subject.	Predicate.	Object.	Enlargement of Obj.	Extensions of Predicate.
1st sentence	I	have heard	it	often wished (*complementary*	soe, allso
6th sentence	(But that) it	may be subdued			through wysedom

Geography.

1. *See same question answered under Geography of Second Year, in this number of Magazine.*

2. Trade-winds are regular winds which blow within the tropics, beyond which they are variable. Monsoons are just another name for the periodical trade-winds blowing in the Indian Ocean and South-eastern Asia. The 'Trades' extend from the equator to the thirtieth parallel N. and S., the limit varying according to the sun's declination, and their action is most regular in the Atlantic and Pacific Oceans. The monsoons blow for six months of the year in one direction, and for the other six in the opposite. The change occurs about the middle of April and October, and is accompanied by sudden and violent gales and thunderstorms.

These winds are caused by the cold currents of air flowing from the polar regions to replace the warmer air which is constantly ascending from the tropics only, and finding its way among the upper strata of the atmosphere back to the regions in which the cold currents take their rise.

3. North of the Tropic of Cancer, the principal groups of islands in the Pacific Ocean are—the *Japan Isles*, *Kurile Isles*, and *Aleutian Isles*. South of the Tropic of Cancer and proceeding from W. to E., we find *Malaysia*, the *Ladrones*, *Caroline Isles*, *Marshall Archipelago*, *Sandwich Isles*, and the *Galapagos Islands* situated on the equator near the west coast of South America. Returning westward we come to the *Marquesas*, *Low Archipelago*, *Society Islands*, *Cook's Islands*, *Navigator's Islands*, *Friendly Islands*, *Fiji Islands*, *Queen Charlotte's Islands*, *Solomon Isles*, *New Hebrides*, and the *New Zealand Group*, the antipodes of England.

History.

1. England has scarcely ever had a king of more consummate ability than Edward III. He tempered a firm and just administration of the law with a munificent generosity and a noble courtesy. The glory of his foreign wars was tarnished by the badness of his cause, and overshadowed by the loss of his conquests, yet they contributed most to the welfare of our country by the opportunities which they offered for obtaining new grants of liberty in return for the means of prosecuting them. Under his rule the hatred which severed Saxon, Norman, and Briton began to disappear, and from the blended races rose the true English nation. Edward offered his protection to Flemish weavers to settle in Norfolk, and the liberty to such immigrants was confirmed by statute.

After conceding to Henry V. every quality, whether personal or intellectual, which can win the admiration of the world for a career of martial glory and successful ambition, it remains to be recorded that he was unscrupulous and cruel to all who crossed his path. No monarch ever occupied the throne who was more the idol of his subjects, nor is any trace to be found of popular dissatisfaction with any part of his government from the beginning to the end of his reign.

Edward III. had some show of reason for making war with France, but Henry V. had none whatever. Under Henry V. the privileges of parliament were further advanced by the king's promise to abstain from altering the terms of laws which he had consented to enact upon their petition.

2. Although Charles II. had signed the Triple Alliance by which he bound himself to aid in curbing the ambition of the French king, yet he secretly sold the common cause to Louis for the promise of a revenue which might enable him to govern without a parliament, and a treaty was secretly signed at Dover by which Charles engaged to make open profession of the Catholic religion and to assist Louis in his schemes on Holland and Spain. Louis, on the other hand, promised Charles a pension of £120,000 while the war lasted, and the aid of 6,000 men in case of an insurrection in England.

3. The English Government had attempted to tax the Colonies in order to defray part of the expenses of protecting them. The Colonists denied the right of the British Parliament, in which they were not represented, to tax them, and claimed the right of taxing themselves in their own assemblies. The first measure of taxation was the Stamp Act, requiring all legal documents to bear stamps. Though this act was repealed within a year, as the colonists threatened rebellion, yet Lord North proposed a tax upon tea simply as an assertion of the right of taxation. Upon this there was much disturbance, and at Boston a cargo of taxed tea was thrown into the harbour. Severe measures were taken by way of punishment, and the breach continued to widen until in 1775 actual war began.

Composition.

ESSAY ON THE HOUSE OF COMMONS.

In the year 1264, when Henry III. was held a prisoner, after the battle of Lewes, by Simon de Montfort, writs were issued directing the sheriffs in the king's name to return two knights for their county and two burgesses for every city and borough contained in it. This is always regarded as the foundation of the House of Commons, the greatest deliberative assembly in the world.

The House of Commons, sitting at Westminster, is composed of the representatives of the third estate of the realm, the Commons, chosen according to law. By the Reform Acts of 1867-68, the composition of the House is 493 members for England and Wales, 60 for Scotland, and 105 for Ireland. These members are chiefly country gentlemen, members of the learned professions, and successful merchants and manufacturers, who, either by their personal talents, social position, or wealth, have been able to inspire the electors of some portion of the country with confidence. No one has a seat in his own right, and none but those elected have permission to enter the chamber, except a few appointed officers.

Formerly it was necessary that a man should possess a certain amount of property to qualify him to sit in Parliament, but now any one may be a member who can induce a constituency to return him, except an alien, a clergyman of either of the Established churches, a Roman Catholic priest, and a few others.

The House of Commons possesses the sole right of levying taxes and of voting money for the public service. Commanding all the sources of supply, they can thus effectually control the sovereign.

According to the theory of the Constitution, no Member of Parliament can resign his seat; but a law now provides that a member who takes a post under the Crown vacates his seat. It has therefore become a custom for those wishing to give up their seat to apply to the Chancellor of the Exchequer for the nominal office of the Stewardship of the Chiltern Hundreds. This office accepted one day, is resigned the next, and so the member is free.

When a new Parliament assembles, the first thing done by the Commons is the electing of a Speaker. The members of both Houses take an oath against conspiracy, treason, etc., according to the terms of the Act of Settlement. There have lately been great differences of opinion as to the taking of this oath, and there is a general inclination to allow *affirming* to supplant the more solemn method.

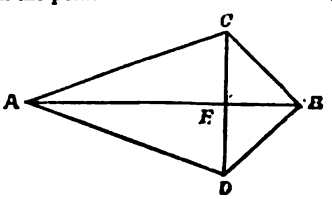
Members of Parliament have many important privileges, one of which is freedom from arrest upon civil matters.

It takes forty members to form a working assembly of the Commons. The decisive words in voting are *Ay* and *No*, and the Speaker has merely a casting vote in cases of equality.

The House *adjourns* from day to day, stands *prorogued* from one session to another, and is *dissolved* to make way for a new Parliament.

Euclid.

1. Prop. 4, Bk. II.
2. Prop. 11, Bk. II.
3. Let the diagonals AB, CD cut one another at right angles in the point E. Then because the angles at E are right angles,



by the 47th Prop., Bk. I., the square on AC is equal to the squares on AE, EC, and the square on BD is equal to the squares on BE, ED. Therefore the squares on AC and BD are equal to the squares on AE, EC, BE, and ED. In the same way it may be shown that the squares on AD and BC are equal to the same four squares, and therefore the squares on the one pair of opposite sides are equal to the squares on the other pair.—Q.E.D.

Algebra.

1. Let $\frac{x}{y}$ represent the fraction,

then $\frac{x+3}{y}=1$, and $\frac{x}{y+2}=\frac{1}{2}$,

or $x+3=y$,, $2x=y+2$,

by substituting $x+3$ for y in 2nd.

$2x=x+3+2$

$x=5$

and so $y=8$

$\therefore$ the fraction $=\frac{5}{8}$. Ans.

2. (a) $3x - 5ax + 2a^2 = (x-a)(3x-2a)$
$2x - 5ax + 3a^2 = (x-a)(2x-3a)$
$\therefore\ x - a = \text{G.C.M.}$

(b) $\left.\begin{array}{l}(1)\ \dfrac{5x-2a}{(x-a)(3x-2a)} = \dfrac{(5x-2a)(2x-3a)}{(x-a)(3x-2a)(2x-3a)} \\ (2)\ \dfrac{2x-5a}{(x-a)(2x-3a)} = \dfrac{(2x-5a)(3x-2a)}{(x-a)(2x-3a)(3x-2a)}\end{array}\right\} =$

$$\frac{(10x - 19ax + 6a^2) - (6x^2 - 19ax + 10a^2)}{(x-a)(2x-3a)(3x-2a)}$$
$$= \frac{4(x^2-a^2)}{(x-a)(2x-3a)(3x-2a)}$$
$$= \frac{4(x+a)}{(2x-3a)(3x-2a)} \quad \text{Ans.}$$

3. (1.) $\left.\begin{array}{l}(1)\ 23x - 21y = 16 \\ (2)\ 24x - 22y = 14 \\ \text{or } (2) = 12x - 11y = 7\end{array}\right\}$ $\begin{array}{l}\text{or } 276x - 252y = 192 \\ \text{or } 276x - 253y = 161\end{array}$

by subtraction $y = 31$
and by substitution $x = 29.$ Ans.

(2.) $\dfrac{2x}{x-4} + \dfrac{2x-5}{x-3} = \dfrac{25}{3}$

L.C.M. of denrs. $= (x-4)(x-3)3$

$\therefore\ 6x^2 - 18x + 6x^2 - 39x + 60 = 25x^2 - 175x + 300$

arranging terms $6x^2 + 6x^2 - 25x^2 + 175x - 18x - 39x = 300 - 60$

collecting $13x^2 - 118x = -240$

dividing by 13 $x^2 - \dfrac{118x}{13} = -\dfrac{240}{13}$

completing the square $x^2 - \dfrac{118x}{13} + (\tfrac{59}{13})^2 = \dfrac{3481 - 3120}{169}$ $= \tfrac{361}{169}$

$x - \tfrac{59}{13} = \pm\tfrac{19}{13}$

$x = \tfrac{59}{13} \pm \tfrac{19}{13}$

$\therefore\ x = 6$, or $3\tfrac{1}{13}$. Ans.

Mensuration.

Total area of court $= 79$ ft. $\times 39$ ft. $= 3081\cdot$ sq. ft.
area of basin $= 14^2 \times {\cdot}7854 \quad = 153{\cdot}9384$ sq. ft.
" plots $= 4(20{\cdot}5 \times 8{\cdot}5) = 697\cdot$
$850{\cdot}9384$

area to be paved $= 2230{\cdot}0616$

$\therefore\ \dfrac{2230{\cdot}0616}{9}$ sq. yds. @ $6\tfrac{3}{4}$d. $= \tfrac{27}{4}$d. $\times \dfrac{2230{\cdot}0616}{9}$

$= £6$ 19s. $4{\cdot}54$d. Ans.

Music.

—o—

Scholarship Examination, 1881.

Arithmetic.

MALES.

Three hours allowed for this Paper.

Candidates are not permitted to answer more than *one* question in each section.

The *solution* must be given at such length as to be intelligible to the examiner, otherwise the answer will be considered of no value.

SECTION I.

Show that 4936 cannot be subtracted 243,096,525 times from 1,199,923,134,424.

Write out square measure.

Express in words 500,007,059,095.

[These form one question.]

SECTION II.

1. 73 bullocks are bought for £6 10s. apiece; they are kept for 7 months at a cost of £25 11s. 6d. per month, and are then sold for £658 7s. 10d.: find the gain on each bullock.

2. There are 100 links in a chain, which is 22 yards long: how many square links will there be in a field which contains $3\frac{1}{2}$ acres?

SECTION III.

1. Compare the fractions $\frac{15}{16}$, $\frac{23}{30}$, $\frac{1117}{1350}$, $\frac{31}{35}$, $\frac{11}{16}$, and find the product of the sum and difference of the greatest and least of them.

2. What number multiplied by $35\frac{1}{5}$ will be less by $5\frac{11}{16}$ than the sum of $3\frac{1}{8}$ and $5\frac{11}{16}$?

SECTION IV.

1. Reduce $\frac{3}{8}$ of $4\frac{1}{5}$ of £1 1s. 8d. to the decimal of £1 7s. 1d.

2. A man possesses ·765 of an estate; he sells ·19 of his share for £612: find the value of the whole estate.

SECTION V.

Write out clearly and concisely the rules for—

(a) finding mentally the value of dozens of articles at a given price per article,

(b) division of fractions,

(c) the pointing in the extraction of a cube root, when the number is partly decimal.

[These form one question.]

SECTION VI.

1. Find (by Practice) the value of 13 tons 1344 lbs., at £39 10s. 6d. per ton.

2. Make out the following bill (deducting 5 per cent. for ready money)—

307 dozens of buttons at $2\frac{1}{4}$d. per dozen.
57 pieces of tape at 3 for $2\frac{1}{2}$d.
180 reels of cotton at $9\frac{1}{2}$d, per score.
89 yards of ribbon at $3\frac{3}{4}$d. per yard.
71 yards of cloth at 1s. $1\frac{1}{2}$d. per yard.

SECTION VII.

1. How many hours a day must 16 Englishmen and 72 Frenchmen work for 34 days to do a piece of work that 24 Englishmen and 12 Frenchmen can do in 95 days of 6 hours each, if 5 Englishmen can do as much in a day as 6 Frenchmen?

2. Find the saving in carpeting a room 18 feet long and 15 feet wide, if, instead of carpeting the whole floor, a width of 3 feet from each wall is stained. The carpet, 18 inches wide, costs 3s. 9d. per yard, and staining costs 4d. per square foot.

SECTION VIII.

1. If a cube containing 31·255875 cubic feet can be exactly contained in a cubical box whose outer edge is $1\frac{1}{4}$ yards, find the thickness of a side of the box.

2. The gross profits of a railway are £450,000, and the working expenses are ·45 of the gross profits: find the capital of the railway if an annual dividend of $3\frac{3}{4}$ is paid.

SECTION IX.

1. Goods are bought for £250, and one-quarter of them are sold at a profit of 15 per cent.: at what profit per cent. must the remainder be sold to obtain a profit of 20 per cent. on the whole?

2. If the price of land falls 30 per cent., so that ·15 of an estate becomes worth £1400, find the original value of the whole estate.

SECTION X.

1. What sum of money at $5\frac{31}{240}$ per cent. per annum simple interest will produce in 15 years the same amount of interest that £500 will produce in 3 years at 5 per cent. per annum compound interest?

2. If I transfer £1000 from 3 per cent. stock at 92 to $3\frac{1}{4}$ per cent. stock, and gain £1 5s. in income, find the price of the latter stock.

ANSWERS.—SCHOLARSHIP EXAMINATION.

SECTION I.

We must first multiply 243,096,525 by 4936

```
     243096525
          4936
   ------------
    1458579150
   729289575
  2187868725
 972386100
 --------------
 1,199,924,447,400
```

Now this number is greater than 1,199,923,134,424.
Hence the result follows.

It might, of course, have been proved by dividing this last number by 4936, and thus obtaining a result which is less than 243,096,525.

500,007,059,095 is equivalent to five hundred thousand and seven million, fifty-nine thousand and ninety-five.

Square measure will be found in any table-book.

SECTION II.

		£	s.	d.
1.	73 bullocks at £6 10s. ... =	474	10	0
	7 months' keep at £25 11s. 6d. =	179	0	6
	Total cost ... =	653	10	6
	Selling price ... =	658	7	10
	Gain on 73 ... ... =	4	17	4
	Gain on 1 ... ... =	0	1	4

Answer 1s. 4d. (a. c.)

2. This may be done by ordinary formula for an acre in links, or thus—

100 links = 22 yards.

10,000 sq. links = 484 sq. yards.

$$=\frac{\overset{4}{\cancel{484}}}{\cancel{121}} \text{ poles} = 16 \text{ poles.}$$

$\therefore$ 100,000 sq. links = 160 poles.
= 1 acre.

$\therefore$ 350,000 sq. links = $3\frac{1}{2}$ acres.

SECTION III.

1. Bring all these fractions to a common denominator, 2850. They become—

$$\frac{2250}{2850},\quad \frac{2185}{2850},\quad \frac{2117}{2850},\quad \frac{2325}{2850},\quad \frac{2090}{2850}$$

Thus the fractions ranged in order, the least being first, run—

$$\frac{11}{15},\quad \frac{2117}{2850},\quad \frac{23}{30},\quad \frac{15}{19},\quad \frac{31}{38}$$

The product of the sum and difference of the greatest and least—

$$=\left(\frac{2325}{2850}+\frac{2090}{2850}\right)\left(\frac{2325}{2850}-\frac{2090}{2850}\right)$$
$$=\frac{4415}{2850}\times\frac{235}{2850}$$
$$=\frac{883}{570}\times\frac{47}{570}$$
$$=\frac{41501}{324900}$$

2. $3\frac{7}{8}+5\frac{11}{16}=8\,\frac{14+11}{16}=9\frac{9}{16}$

$9\frac{9}{16}-5\frac{11}{64}=4\,\frac{36-11}{64}=4\frac{25}{64}$

$$\frac{4\frac{25}{64}}{35\frac{1}{8}}=\frac{\frac{\cancel{281}}{64}}{\frac{\cancel{281}}{8}}=\frac{1}{8}.\ \text{Answer, } \frac{1}{8}.$$

SECTION IV.

1. £1 1s. 8d. = £1 $1\frac{2}{3}$s. = £1 $\frac{\frac{5}{3}}{20}$ = £1 $\frac{1}{12}$

£1 7s. 1d. = £1 $7\frac{1}{12}$s. = £1 $\frac{\frac{85}{12}}{20}$ = £1 $\frac{17}{48}$

$$\frac{\frac{3}{7}\text{ of }4\frac{1}{5}\text{ of }\frac{13}{12}}{1\frac{17}{48}}=\frac{\frac{3}{\cancel{7}}\times\frac{\overset{3}{\cancel{21}}}{5}\times\frac{\cancel{13}}{\underset{4}{\cancel{12}}}}{\frac{5}{\frac{\cancel{65}}{\underset{12}{\cancel{48}}}}}$$

$$=\frac{36}{25}=\frac{144}{100}=1{\cdot}44.$$

2. $\cdot 1\dot{9}$ = by the ordinary rule for evaluation of such things, $\frac{18}{90}=\frac{1}{5}$

$\therefore$ $\frac{1}{5}$ of $\cdot 765$ of an estate is worth £612.
$\cdot 153$ " " £612.
$\cdot 001$ " " £4.
$\therefore$ The estate is worth £4000.

SECTION V.

(*a*) Price of one dozen articles. Convert price of one article into pennies. The price of one dozen is as many shillings as there are pennies.

(*b*) To divide one fraction by another. Multiply the numerator of the first fraction by the denominator of the second, and divide the result by the product of the numerator of the second fraction multiplied by the denominator of the first fraction.

(*c*) Point the integral and decimal parts separately. For the integral, count the places from the units backward, and put dots on the 1st, 4th, 7th, etc., figures. For the decimal, count the places in the opposite way, and put dots on the 3rd, 6th, etc.

SECTION VI.

1. 13 tons, 1344 lbs.
= 13 tons, 12 cwt.

	£	s.	d.
10 cwt. = $\frac{1}{2}$	39	10	6 × 3
		10	
	398	9	0
	118	11	6
2 cwt. = $\frac{1}{5}$	19	15	3
	3	19	$0\frac{3}{5}$
	£540	14	$9\frac{3}{5}$

2.

	£	s.	d.
307 doz. buttons @ $2\frac{1}{2}$d. ...	3	3	$11\frac{1}{2}$
57 pieces tape @ 3 for $2\frac{1}{2}$d.	0	3	$11\frac{1}{2}$
9 score cotton @ $9\frac{1}{2}$d. ...	0	7	$1\frac{1}{2}$
89 yards ribbon @ $3\frac{3}{4}$d. ...	1	7	$9\frac{3}{4}$
71 yards cloth @ $13\frac{1}{4}$d. ...	3	18	$4\frac{3}{4}$
	£9	1	3
5% cash discount	0	9	$0\frac{3}{4}$
	£8	12	$2\frac{1}{4}$

SECTION VII.

1. 5 Englishmen are equivalent to 6 Frenchmen,
$\therefore$ 24 Englishmen + 12 Frenchmen are equivalent to (24 + 10) Englishmen, *i.e.*, 34 Englishmen;
16 English + 72 French = (16 + 60) Eng. = 76 Eng.
34 men do the work in 95 × 6 hours;
$\therefore$ 1 man " " 34 × 95 × 6 hours;
$\therefore$ 76 men " " $\frac{34\times 95\times 6}{76}$ hours.

But they take 34 days,

$\therefore$ they work $\frac{95\times 6}{76}=\frac{5\times 6}{4}=7\frac{1}{2}$ hours per day.

2. We will first find cost of carpeting.
Since the room is 18 × 15 feet, and carpet 18 in. broad,
Evidently 12 × 15, or 180 feet are required;
60 yards at 3s. 9d. = £11 5s.

A width of 3 feet from each wall is stained. The carpeted portion therefore measures (18 − 6) (15 − 6) or 12 × 9.

$$\therefore \frac{\overset{4}{\cancel{12}}\times 9\times 2}{\cancel{3}}=72 \text{ feet are required.}$$

24 yards at 3s. 9d. = £4 10s.
Also there is (18 × 15 − 12 × 9) square feet to stain, *i.e.*, 9 (30 − 12)
i.e., 9 × 18;
9 × 18 feet at 4d. = 54s. = £2 14s.
Therefore total cost = £7 4s.
Saving effected is £4 1s.

SECTION VIII.

1. We proceed to find the cube root of 31·255875 in order to find the edge of the cube.

```
          31·255875(3·15
          27
 91 | 2700 | 4255
        91 | 2791
      2791 | 1464875
         1 |
935 | 288300 | 1464875
        4675 |
      292975 |
```

Now the cube whose edge is 3·15 feet is contained in a box whose edge is 3·75 feet.

∴ ·6 = twice the thickness of the box ;

∴ ·3 feet = thickness of box

= 3·6 inches.

2. ·45 being paid in working expenses,

·55 is left to be divided in profits.

This gives a dividend of $3\frac{3}{4}$.

∴ $\frac{15}{4}\times\frac{1}{100}$ of the capital = ·55 × £450,000 ;

$$\therefore \text{ the capital} = \frac{55\times 4}{\cancel{15}}\times £\overset{30,000}{\cancel{450},000}$$

$$= £66,000,000$$

SECTION IX.

1. One-quarter realizes 15% ;

$$\therefore \text{ this quarter sells for } \frac{115}{\underset{2}{\cancel{100}}}\times\frac{\overset{5}{\cancel{250}}}{4} = £\frac{575}{8}$$

Selling price of the whole, so as to gain 20 per cent. is

$£\frac{120}{100}\times 250 = £300$

∴ the remaining three-quarters must sell for

$£(300-\frac{575}{8})$ *i.e.*, $£\frac{1825}{8}$

$£\frac{750}{4}$ worth of goods sells for $£\frac{1825}{8}$;

£100 „ „ „ $\frac{1825}{2\times 750}\times 100$

$=\frac{1825}{15}=\frac{365}{3}=121\frac{2}{3}$.

Therefore the remaining goods must sell at a profit of $21\frac{2}{3}$ p. c. To verify this result, observe that $\frac{3}{4}\times 21\frac{2}{3}+\frac{1}{4}\times 15=20$, as it should do. The sum might have been worked by this last method, but perhaps the formula assumed is not obvious to all.

2. Original value of estate evidently is $\frac{100}{\cancel{70}}\times\frac{100}{\underset{3}{\cdot\cancel{15}}}\times\overset{4}{\cancel{\overset{\cancel{20}}{\cancel{1400}}}}$

$=\frac{40000}{3}=£13,333$ 6s. 8d.

SECTION X.

1. The amount of £500 in 3 years at 5 p. c. compound interest, is easily seen to be £500 $(1·05)^3$ = £500 (1·157625)

```
= £578· 8125
          20
   S 16·250
          12
       D 3·
```

Hence the amount is £578 16s. 3d.

We shall find it more convenient to use the decimal form.

£100 at rate named, in 15 years becomes $£\frac{2861}{16}$

∴ £2861 is produced by £1600.

$£578·8125-\frac{1261}{2861}\times(578·8125)$,

$=\frac{1600}{2861}\times\frac{9261}{16}=£\frac{926100}{2861}$

As 2861 is a prime, this is incapable of simplification.

Its value is £323 13s. $11\frac{1493}{2861}$d.

2. Income from £1000 in 3 p. c. is £30. They sell at £920, and the income is now £31 5s.

£920 produces $£31\frac{1}{4}$

$\frac{\overset{184}{\cancel{920}}}{\underset{25}{\cancel{125}}}\times 16$ produces £4

∴ the stock is at $\frac{2944}{25}$; *i.e.*, $£117\frac{19}{25}$.

Euclid, Algebra, and Mensuration.

MALES.

Three hours allowed for this paper.

Candidates in Scotland may answer two questions out of Section IV. if they omit Section IX. With this exception Candidates are not permitted to answer more than *one* question in each section. (Marks are given for portions of questions.)

Euclid.

N.B.—Capital letters, not numbers, must be used in the diagrams.

The only signs allowed are + and =. The square on AB may be written 'sq. on AB,' and the rectangle contained by AB and CD, 'rect. AB, CD.' Other abbreviations (if employed) must not be ambiguous.

SECTION I.

Complete the following definitions :—

'A diameter of a circle is a straight line terminated by the circumference.'

'A square is a figure which has all its sides equal.'

State the exceptions to the following rule: if in two triangles three of their parts, *i.e.*, of their three angles and three sides, be equal, each to each, the other three parts will also be equal, each to each.

Write out the axiom concerning parallel straight lines.

(These form one question.)

SECTION II.

1. The angles at the base of an isosceles triangle are equal to each other.

2. To bisect a given rectilineal angle.

The three lines which bisect the angles of an equilateral triangle meet in a point.

3. If a straight line, falling on two other straight lines, make the alternate angles equal to one another, these two straight lines will be parallel.

A line, drawn through the vertex of an isosceles triangle parallel to its base, will make equal angles with the two sides of the triangle.

SECTION III.

1. To describe a parallelogram equal to a given square and having one of its angles equal to half a right angle.

2. To describe a square upon a given straight line.

If the square be described upon the semi-diameter of another square, compare the areas of the two squares.

3. If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by those parts.

SECTION IV.

1. If a straight line be divided into two equal and also into two unequal parts, the squares on the two unequal parts are together double of the square on half the line, and of the square on the line between the points of section.

2. The angle in that segment of a circle which is less than a semicircle is greater than a right angle.

If the angle in a segment of a circle be double of the angle in the other segment, compare the arcs.

3. Two circles have the same centre ; show that if a chord of the outer circle touch the inner circle all chords that are equal to it will touch the same circle.

Algebra.

SECTION V.

Multiply $1-x^2+x^4-x^6$ by $1+x^2$.

Divide $x^4+\frac{9}{4}x^3+\frac{21}{8}x^2+\frac{33}{16}x+\frac{5}{16}$ by $x^2+\frac{3}{2}x+\frac{1}{4}$

Find the value of $\sqrt{a^2b^3}+\sqrt[3]{a^3b^3}+\sqrt[6]{a^2b^3}$ when $a=5$, $b=25$.

(These form one question.)

SECTION VI.

1. Find the G.C.M. of $x^4+7x^3+6x^2-32x-32$ and $x^2+9x+20$.

2. Find the L.C.M. of x^2-y^2, $x^2+xy-2y^2$ and $x^2+3xy+2y^2$.

3. What is the condition that x^2+px+q may be divided by $x-r$?

SECTION VII.

Solve the equations—

(1) $16 - 4x + 8x = 5x + 14.$

(2) $\left.\begin{aligned} 8x - 4y &= 5 \\ \frac{9x}{2} &= y + 5 \end{aligned}\right\}$

(3) $\sqrt{x^2 + 16x} + 7 = 3x - 5$

(These form one question.)

SECTION VIII.

(*a*) The breadth of an oblong space is four yards less than its length; the area of the space is 252 square yards; find the length of its sides.

(*b*) A regiment has sufficient food for *m* days; but if it were reinforced by *p* men, would have food enough for *n* days only, find the number of men in the regiment.

(These form one question)

Mensuration.

SECTION IX.

1. A triangular space whose sides are in the ratio, 5 : 5 : 6 contains 588 square yards, find the length of its sides.

2. A cottage which stands on a square plot of 729 feet, contains four rooms of equal size on the ground floor, and is divided into two equal parts by a passage four feet wide, having two rooms on each side; allowing one foot for the thickness of each wall, find the area of each of the four rooms.

ANSWERS.—SCHOLARSHIP EXAMINATION.

Euclid.

MALES.

SECTION I.

A diameter of a circle is a straight line passing through the centre, and terminated both ways by the circumference.

A square is a four-sided figure which has all its sides equal, and one angle a right-angle.

(Euclid's definition is that all the angles are right-angles. There are objections to this. Of course all the angles of a square *are* right-angles, but to state so as an axiom is to assume what is capable of proof; see Euc. I. 46, from the *data* we have. This violates the logical laws of definition.)

This rule is true—

(1) All sides equal.
(2) Two sides and included angle.
(3) Two angles and a corresponding side.
(4) Two sides and any other angle, provided a limitation be imposed similar to that in VI. 7 (namely, that this angle be symmetrically placed, and that the remaining corresponding pairs of angles should each be either both not less, or both less than, a right angle, or one of them equal to a right angle).

The rule is not necessarily true—

(1) All angles equal.
(2) When in the fourth case of the preceding the limitation of VI. 7 is not imposed.
(3) When parts not symmetrically placed are equated under the conditions of the preceding. For instance, if in ABC and DEF AB = DF, and ABC = DEF, and ABC = DFE, the equality of the remainder does not necessarily follow. Nevertheless it may happen.

The twelfth axiom is the one which refers to parallel straight lines.

SECTION II.

[References which are sometimes, for the sake of brevity, omitted here, should always be inserted in the actual examination.]

1. Euc. I. 5.

2. Euc. I. 9.

Let ABC be the equilateral triangle, and let BDF, CDG bisect respectively the angles at B and C, meeting the opposite sides in F and G. These lines must intersect. (Ax. 12.). Join AD.

Then, as it is proved in Euc. I. 10,

$\left.\begin{array}{l}\text{AG is one half of AB}\\ \text{AF is one half of AC}\end{array}\right\}$ and AB and AC are equal.

∴ AG is equal to AF.

Also we have by the same proof AGD a right angle and equal to AFD.

Hence, by Euc. I. 47—

Sq. on AD = sum of sqs. on AG and GD
= sum of sqs. on AF and FD

But sq. on AG = sq. on AF

Hence sq. on GD = sq. on FD

Hence GD = FD.

Hence in the triangles AGD, FAD, we have the three sides equal, each to each.

∴ the angle FAD = DAG.

This proves the proposition.

3. Euc. I. 27.

Let ABC be the isosceles triangle of which A is the vertex, and let EAF be the parallel to BC drawn through the vertex A, E being on the same side of AC as is B.

Then we have at once by Euc. I. 29 that the angle EAB = ABC = BCA = CAF, since the triangle is isosceles.

SECTION III.

1. Euc. I. 45, half a right angle being obtained from a right angle by Euc. I. 9.

2. Euc. I. 46.

If *a* be a side of the original square, by Euc. I. 47.

Square on diameter = sum of squares on two sides $= 2a^2$.

Therefore square or semi-diameter $= \frac{2a^2}{4} = \frac{a^2}{2} = \frac{1}{2}$ (area of original square).

Or thus, without any algebraical notation :—

Let ABCD be the square, and let AC and BD meet in E. Draw AF parallel to BD and DF parallel to AC.

Then we have AB = BC.

∴ BAC = ACB = CAD.

Now in the triangles BAE, DAE, BA = AD, AE is common and BAE = DAE,

.. the angle AED = the angle AEB = rt. angle and BE = ED.

Now EAD is half a right angle and AED is a right angle.

∴ EDA is half a right angle (Euc. I. 32) ∴ AE = ED.

But AEDF is a parallelogram,

∴ since AE = ED, it has all its sides equal (Euc. I. 34),

and EAD is a right angle.

∴ AEDF is by definition the square on ED.

Also this square (I. 34) = 2△AED = △ABE + △AED = △ABD = $\frac{1}{2}$ area ABCD.

3. Euc. II. 4.

SECTION IV.

1. Euc. II. 9.

2. Euc. III. 31.

The angle in one segment is double the angle in the other, ∴ by Euc. VI. 33 the arc of the second segment is double that of the first.

3. In a circle equal chords are equidistant from the centre. Suppose then there are two equal chords of the outer circle, one of which touches the inner concentric circle. The distance of the first chord from the centre is the radius of the inner circle; this, therefore, is the distance of the second chord, therefore the second chord touches the inner circle.

SECTION V.

$$\begin{aligned} &(1 - x^2 + x^4 - x^6)\,(1 + x^2) \\ &= \{1 - x^2 + x^4\,(1 - x^2)\}\,(1 + x^2) \\ &= \{1 - x^2\}\,(1 + x^4)\,(1 + x^2) \\ &= (1 - x^4)\,(1 + x^4) = 1 - x^8. \end{aligned}$$

By successive applications of the rule that $(a+b)\,(a-b)$ is $a^2 - b^2$.

$$x^2 + \tfrac{1}{2}x + \tfrac{1}{4}\Big)\; x^4 + \tfrac{5}{4}x^3 + \tfrac{15}{8}x^2 + \tfrac{13}{16}x + \tfrac{5}{16}\;\Big(x^2 + \tfrac{3}{4}x + \tfrac{5}{4}$$

$$\begin{array}{r} x^4 + \tfrac{1}{2}x^3 + \tfrac{1}{4}x^2 \\ \hline \tfrac{3}{4}x^3 + \tfrac{13}{8}x^2 + \tfrac{13}{16}x \\ \tfrac{3}{4}x^3 + \tfrac{3}{8}x^2 + \tfrac{3}{16}x \\ \hline \tfrac{10}{8}x^2 + \tfrac{10}{16}x + \tfrac{5}{16} \\ \tfrac{10}{8}x^2 + \tfrac{10}{16}x + \tfrac{5}{16} \end{array}$$

Ans. $x^2 + \frac{3}{4}x + \frac{5}{4}$.

$\sqrt{a^3b^3} + \sqrt[3]{a^3b^3} + 6\sqrt{a^2b^2}$

$= ab\sqrt{b} + ab + \sqrt[3]{ab}$. For $\left\{\begin{array}{l} ab\sqrt{b} = \sqrt{a^2b^2\,b} = \sqrt{a^2b^3} \\ 3\sqrt{ab} = \sqrt[3]{\sqrt{a^2b^2}} = \sqrt[6]{a^2b^2} \end{array}\right\}$]

$$\begin{aligned} &= 5 \times 25\,\sqrt{25} + 5 \times 25^2 + \sqrt{5 \times 25} \\ &= 25^2 + 125 + 5 \\ &= 625 + 125 + 5 \\ &= 755. \end{aligned}$$

SECTION VI.

1. $x^2+9x+20)\ x^4+7x^3+6x^2-32x-32\ (x^2-2x+4$

$$\begin{array}{r} x^4+9x^3+20x^2 \\ \hline -2x^3-14x^2-32x \\ -2x^3-18x^2-40x \\ \hline 4x^2+8x-32 \\ 4x^2+36x+80 \\ \hline -28x-112 \\ \hline x+4 \end{array}$$

$x+4)\ x^2+9x+20\ (x+5$

$$\begin{array}{r} x^2+4x \\ \hline 5x+20 \\ 5x+20 \\ \hline \end{array}$$

Ans. G.C.M. is $x+4$.

2. $x^2-y^2=(x-y)(x+y)$

$x^2+xy-2y^2=(x+2y)(x-y)$

$x^2+3xy+2y^2=(x-2y)(x+y)$

$\therefore$ L.C.M. is $(x+2y)(x-y)(x+y)$

i.e., $x^3+2x^2y-xy^2-2y^3$

3. If x^2+px+q be divisible by $x-r$, it must have another factor of the form $x+s$

$\therefore\ x^2+px+q=(x-r)(x+s)$

This equation is true for all values of x. Put $x=r$

$r^2+rp+q=(r-r)(r+s)$

$=0$

This, then, is the condition that x^2+px+q should be divisible by $x-r$.

SECTION VII.

1. $16-4x+8x=14+5x$

$\therefore\ 16-14=5x+4x-8x$

$\therefore\ 2=x.$

2. $8x-4y=5$

$9x=2y+10$ (multiplying the second given equation by 2)

$9x-2y=10$

$\therefore\ 18x-4y=20$

But $8x-4y=5$

$\therefore$ subtracting $10x=15$; $x=\frac{3}{2}$. Substituting this in the first equation, $12-4y=5$; $4y=12-5=7$; $y=\frac{7}{4}$.

3. $\sqrt{x^2+16x}+7=3x-5$

$\therefore\ \sqrt{x^2+16x}=3x-12$ (square both sides)

$x^2+16x=9x^2-72x+144$

$\therefore\ 8x^2-88x+144=0$

$x^2-11x+18=0$

$(x-9)(x-2)=0$

$x=9$ or 2

SECTION VIII.

(*a*) Let x be breadth, then $x+4$ is length of space.

$\therefore\ x(x+4)$ is area

$\therefore\ x(x+4)=252$

$\therefore\ x^2+4x=252$

$x^2+4x+4=256$

$x+2=\pm 16$

$\therefore x=14$, for the *minus* value is of course inadmissible

$\therefore$ Dimensions are 14 and 18.

(*b*) Let x be the number of men.

Food lasts x men m days.

$\therefore$ it would last 1 man mx days.

But also we are told it would last $x+p$ men n days

$\therefore$ it would last 1 man $n(x+p)$ days

$\therefore\ mx=n(x+p)$

$\therefore\ (m-n)x=np$

$\therefore\ x=\dfrac{np}{m-n}$

Mensuration.

SECTION IX.

1. Suppose the sides to be $5x$, $5x$, $6x$.

Then s, semi-perimeter $=8x$

$s-a=3x$

$s-b=3x$

$s-c=2x$

$\therefore$ Area $=\sqrt{s.(s-a)(s-b)(s-c)}$

$=x^2\sqrt{8 \cdot 3^2 \cdot 2}$

$=x^2 \cdot 4 \cdot 3=588$ sq. yards.

$\therefore\ 12x^2=588$; $x^2=49$; $x=7$, the minus value being inadmissible

$\therefore$ the sides are 35, 35, 42.

2. The square plot has sides of 27 feet (*i.e.*, $\sqrt{729}$).

Consider a section parallel to the passage. We have two outside walls, and one internal wall. Total, 3 feet.

$\therefore$ Each room measures $\frac{27-3}{4}=12$ feet in this direction.

Consider a section perpendicular to passage. We have two outside walls, and, because of the passage, two internal walls. Total, 4 feet.

Hence each room this way measures $\frac{27-4}{2}=11\frac{1}{2}$ feet

$\therefore$ The area of each of four rooms is $\frac{23}{2}\times 12=138$ sq. feet.

Languages.

French.

1. Translate into English:—

Mon malheureux frère n'avait pas besoin de cet ordre : dès le premier moment, il s'était dit qu'il n'avait plus qu'un devoir : retrouver sa sœur et son amie, dût-il, pour accomplir son entreprise, affronter mille morts. Il eût voulu seulement emporter avec lui comme un gage de succès, comme une consécration divine, la bénédiction de son père ; et loin de là, c'était sous le poids de l'anathème qu'il devait quitter l'auteur de ses jours, et courir le monde à la recherche de sa sœur chérie. Ce dernier coup du sort lui fut le plus cruel ; mais, si tout d'abord il s'était senti écrasé sous ce comble d'infortune imméritée, il finit par puiser dans l'horreur même de sa situation une énergie sauvage et surhumaine. Désormais il était prêt à tout.

2. Parse fully il s'était dit, dût-il, chérie, fut, eût voulu, puiser, surhumaine.

3. (*a*) Give the feminines of grand, neuf, majeur, acteur, épais, sec, frais.

(*b*) Give the imperative mood of the verb s'habiller.

(*c*) 'Not' is generally translated by *ne—pas* and *ne—point;* in what case should *pas* and *point* be omitted?

4. Translate into French :—

(*a*) Are you a Frenchman or a German?

(*b*) I could not tell it you.

(*c*) All that you say is true.

(*d*) How long have you been learning French?

(*e*) It is just five minutes to ten.

(*f*) They told me that you were thirsty.

(*g*) Why do you not think of what you are doing?

5. Translate into French :—

My unhappy sister said to herself that she ought to discover her brother; and would have wished to take with her her mother's blessing. But, as she could not obtain the blessing, she must traverse the world without hope, and the actual sorrow gave such superhuman energy, that from that moment she was prepared for anything.

1. My unhappy brother had no need of this command : from the first moment he had said to himself that he no longer had but one duty to fulfil : to find his sister and friend, to accomplish his task, it would be necessary to face (brave) a thousand deaths. He had desired to take away with him as a token of success, as a divine command (*consecration*), his father's blessing; but far from that, it was under the burden of the curse that he was to leave his father and traverse the world in search of his beloved sister. This last blow (of fate) was (to him) the most cruel (of all); but if at the onset he had felt himself crushed under this accumulation of undeserved misfortune, he at last drew from the very horror of his condition a wild and superhuman courage. Thenceforth he was ready for anything.

2. *Il s'était dit*—3rd sing., pluperfect indicative of *se dire.*

Dût il—3rd sing., perfect subjective of *devoir.*

chérie—verbal adjective, sing., fem.

lui—pronoun, dative case of *il*, governed by *cruel.*

fut—3rd sing., past defin. of *être.*

eût voulu—3rd sing., 3rd conditional of *vouloir.*

puiser—infinitive mood (1st conjugation).

surhumaine—adj. fem. sing. of *surhumain.*

3. (*a*) Grande, neuve, majeure, actrice, épaisse, sèche, fraiche.

(*b*) Habille-toi. Habillons-nous.

Qu'il s'habille. Habillez-vous.

Qu'ils s'habillent.

(*c*) Mostly after the verbs cesser, oser, pouvoir, savoir (meaning pouvoir), and savoir (to know) if followed by si (if, whether).

4. (*a*) Etes-vous français ou allemand ?
   (*b*) Je ne pourrais (pouvais) vous le dire.
   (*c*) Tout ce que vous dites est vrai.
   (*d*) *Combien de temps y a-t-il que vous apprenez la langue française?* or, Depuis quand apprenez-vous le français ?
   (*e*) Il e.t exactement dix heures moins cinq (minutes).
   (*f*) On m'a dit que vous aviez soif.
   (*g*) Pourquoi ne pensez-vous pas à ce que vous faites ?

5. Ma malheureuse sœur se dit qu'elle devait retrouver son frère, et elle aurait voulu emporter avec elle la bénédiction de sa mère. Mais comme elle ne put obtenir la bénédiction, elle devait courir le monde sans espérance (espoir); et le chagrin actuel lui donna une énergie si surhumaine que désormais elle était prête à tout.

German.

I. Translate into English—

Er hatte eine junge Person geheirathet, eine stille, leidliche Natur. Sie versah ihr Geschäft gut und pünktlich, sie hing an ihrem Hauswesen, sie liebte ihren Mann; doch mußte sie ihn bei sich im Stillen tadeln, daß er mit dem Gelde nicht sorgfältig genug umging. Das baare Geld nöthigte ihr eine gewisse Ehrfurcht ab; sie fühlte ganz den Werth desselben, sowie die Nothwendigkeit, sich überhaupt in Besitz zu setzen, sich dabei zu erhalten. Ohne eine angeborne Heiterkeit tes Gemüths hätte sie alle Anlangen zum strengen Geize gehabt. Doch ein wenig Geiz schadet dem Weibe nichts, so übel sie die Verschwendung kleidet. Freigebigkeit ist eine Tugend, die dem Manne ziemt, und Festhalten ist die Tugend eines Weibes. So hat es die Natur gewollt, und unser Urtheil wird im Ganzen immer naturgemäß ausfallen.

II. Parse fully versah, stillen, umging, desselben, Geize, Festhalten, gewollt.

III. (*a*) Give the plurals of Mutter, Kind, Tiger, Bruder, Hund, Blatt, Stück.
   (*b*) Give the accusative cases of er, jemand, dieser, wer, guter Mann, schöne Frau.
   (*c*) Give the imperfect tenses of fliehen, leiden, treiben, finden, nehmen, kommen, rufen, wissen, wollen, sich freuen.

IV. Translate into German—
(*a*) Take this letter to the post.
(*b*) Who has given you this orange ?
(*c*) This is the little girl who plays so well.
(*d*) My father is richer than yours.
(*e*) Why are you not dressed yet ?
(*f*) My brother was born on the 22nd of May.
(*g*) Since my brother broke his leg, he has been lame.

I. He had married a young person of a quiet, tolerable (placid) nature. She did her work well and punctually, she acquitted herself of (stuck to) her domestic duties, she loved her husband, yet she had to blame him in her mind (silently) because he was not careful enough of his money. Ready money inspired her with a certain respect; she thoroughly felt the value of it, as well as the necessity of putting herself generally in possession of it, in order to maintain herself. Without an innate gaiety of soul, she had had all the propensities of (for) an avaricious mind. However (still), a little avarice does no harm to a wife, no matter how badly she hides her extravagance. Liberality is a virtue which becomes a man, and steadfast possession (holding tight) is the virtue of a woman. Nature would have it so (has so determined it), and, in conformity with nature, our judgment will always fall out in the whole (fail on the whole).

II. Versah—Imperfect indicative, 3rd person singular, agrees with its subject sie; from versehen, versah, versehen.
   Stillen—Adjective used substantively, neuter, singular, dative case, governed by in
   Umging—Imperfect indicative, 3rd person singular, agrees with its subject er; from umgehen, umging, umgegangen.
   Desselben—Genitive singular of dasselbe, neuter, governed by Werth.
   Geize—Masculine common noun, dative singular of Geiz, governed by zu.
   Festhalten—Present infinitive, used substantively, neuter, singular, subject of ist.
   Gewollt—Past participle of wollen, ich will, wollte, gewollt.

III. (*a*) Mütter, Kinder, Tiger, Brüder, Hünde, Blätter, Stücke.
   (*b*) Ihn, jemanden, diesen, wen, guten Mann, schöne Frau.
   (*c*)

ich floh	litt	trieb	fand	nahm	kam
du flohst	littst	triebst	fandst	nahmst	kamst
er floh	litt	trieb	fand	nahm	kam
wir flohen	litten	trieben	fanden	nahmen	kamen
ihr flohet	littet	triebet	fandet	nahmet	kamet
sie flohen	litten	trieben	fanden	nahmen	kamen

ich rief	wußte	wollte	freute mich
du riefst	wußtest	wolltest	freutest dich
er rief	wußte	wollte	freute sich
wir riefen	wußten	wollten	freuten uns
ihr riefet	wußtet	wolltet	freutet euch
sie riefen	wußten	wollten	freuten sich

IV. (*a*) Nehmen Sie diesen Brief auf die Post.
   (*b*) Wer hat Ihnen diese Pomeranze gegeben?
   (*c*) Dieses (hier) ist das kleine Mädchen, das so gut spielt.
   (*d*) Mein Vater ist reicher als der Ihrige.
   (*e*) Warum sind Sie noch nicht angekleidet?
   (*f*) Mein Bruder wurde am 22sten (zweiundzwanzigsten) Mai geboren.
   (*g*) Seitdem mein Bruder sich den Bein {gebrochen hat / brach} ist er lahm gewesen (geworden).

—o—

Concerning our Reviews in General and one in Particular.

BY THE EDITOR.

IT is now many years ago since we made the acquaintance—in one of Bret Harte's sketches, we believe it was—of a cautious American editor who in self-defence deemed it advisable to keep a 'six-shooter' in his office. In those days we laughed at the idea as a creation of the brilliant writer's thrown in to heighten the effect of his picture. Now, however, our opinion is changed; we give the humorist's story full credence, and are seriously thinking of equipping ourselves with the necessary 'derringer.'

The fact is, our editorial experience of the past month has not been the most enviable in the world. Why? Listen.

It is pretty generally agreed that the 'Review Column' is not the least important part of a journal. This remark applies with additional force to a journal of any educational pretensions, for there are in outlying districts thousands of teachers whose opinion of current literature is almost exclusively formed from the 'reviews' which appear in the paper they honour with their support. And these teachers, in common with their more favoured brethren, are largely influenced in their choice of school-books by press notices. How essential, then, that these criticisms should be honest and impartial! Our readers will be surprised to learn that on more than one occasion we have been asked to write the reviews of publications of which we were either the author or publisher. And we have the best reasons for believing that other London firms have been pestered with similar requests. As regards ourselves, we can only add that neither in this journal nor any other have we penned the notice of a single work written or published by us.

When the PRACTICAL TEACHER was launched we determined, so far as we were able, to put down this pernicious practice, and to let each book stand or fall on its own merit or demerit, irrespective of author or publisher. How far we have succeeded in our attempt it is for our readers to say. Able men, far above suspicion, have been entrusted with the work, and we believe have faithfully carried out their instructions to 'be just and fear not.' Amidst a host of congratulatory letters from all parts of the world, we have occasionally received a growl from an author whose work has been adjudged inferior. It is always pleasanter to

praise than blame; to point out excellences rather than defects; still we have a public duty to discharge, and we hold that we fail in our most important office if we shrink from placing before our constituency candid criticisms of works sent to us for review.

And here we think we may, under the circumstances, be pardoned for printing the following critique, upon which we set more value than upon all the flattering notices with which we have been favoured. We cull it from *The Journal of Education*, a monthly paper, to which the first literary men and women of the day contribute:—

'An excellent feature of the PRACTICAL TEACHER is the *Reviews*—genuine criticisms, not those perfunctory puffs which are a standing disgrace to most of our educational contemporaries.'

So much for our reviews 'in general': now for the 'one in particular.'

On the 29th of June we were honoured with a visit from two gentleman, one of whom was a diminutive, pleasant-looking, light-haired, mercurial Frenchman, by name Mr. Mast. The other was Mr. Boulton—the publisher who has lately made an arrangement to sell Mr. J. S. Laurie's works—a taller and better-built man, with dark hair, slightly Jewish cast of countenance, and a more commanding presence—at least, he evidently thought so.

After the preliminaries of introduction, and some nonsense from Mr. Boulton, the author was invited to speak. When we say that Mr. Mast is a little Frenchman, that he speaks with a strongly-marked foreign accent, that he can with ease assume all the ingenious attitudes of his countrymen, and that he considered himself sorely wronged on account of a review which appeared in the July issue of the PRACTICAL TEACHER, our friends will know we had a lively half-hour.

His chief grievance was that we had entrusted his book to a personal enemy of his, and that the notice had been written out of pure spite. We assured Mr. Mast that the reviewer was unknown to him—indeed, that he had never even heard of his (Mr. M.'s) existence prior to the receipt of the book. This assertion was met with a flat denial by the irate Frenchman, who, shaking his fist in our face, shouted, or rather screeched at the top of his voice, 'I know him, I know who wrote it!' As Mr. Mast never either saw or heard of the writer, we are obliged to him for the conclusive proof which he gives us, that there is one individual other than our contributor living, blind to the excellences of his French book.

To convince Mr. Mast beyond a doubt that our reviewer was unknown to him, we offered there and then, in the presence of Mr. Boulton, to give his name and address, and also promised to state in our next issue that the strictures referred to the *book*, and not to the *author personally*. This we now most gladly do. We had never exchanged a word with Mr. Mast, knew nothing whatever about him, and therefore could not possibly be prejudiced against him. And we think any English man or woman blessed with an average amount of common-sense would never put Mr. Mast's construction on the critique. The only satisfactory explanation which suggests itself to our mind is, that the author, being a foreigner, does not quite understand our idioms, and therefore accepts *personally* what was meant for his *book*.

After cooling down, both the author and publisher expressed themselves satisfied with the course we proposed to adopt, and upon parting we shook hands. We were therefore surprised to hear subsequently from Mr. Mast's solicitor.

The correspondence appended speaks for itself:—

9, Charles Square, Hoxton, N.
2nd July, 1881.

SIR,—I have been consulted by Mr. G. C. Mast, the author of a school-book on 'French Practice and Theory,' etc., in reference to an article which you have thought fit to publish in the present month's number of the PRACTICAL TEACHER, which is edited by you, reflecting not only most adversely, but, as he is advised, most unfairly on such work, and on himself as the author of it. As such criticism, from first to last of your article, is calculated to hinder the future sale of my client's book 'as a compound of nonsense,' etc., and to hold him up to ridicule as wholly incompetent to teach the French language, as he professes to do by it, I must request you to retract what you have so written, by signing an apology for having so slandered my client, to be prepared by me, and to be published by you as he may direct. Unless you do this, and pay my charges, on or before Tuesday next, I shall be compelled to take proceedings against you for the unlawful act you have so committed, and to recover damages which Mr. Mast has sustained and is likely to sustain by reason of it. Yours most obediently,

Mr. Joseph Hughes, ALFRED ASHLEY.
Editor of the PRACTICAL TEACHER,
Pilgrim Street, Ludgate Hill, E.C.

Pilgrim Street, Ludgate Hill,
London, E.C. July 4th, 1881.

Mr. Alfred Ashley,
9, Charles Square, Hoxton, N.

Dear Sir,—I beg to acknowledge the receipt of your letter of the 2nd inst., in which you ask for an apology for publishing the critique on Mr. G. C. Mast's 'French Practice and Theory' in the current number of the PRACTICAL TEACHER. As the writer of the notice complained of is a man of proved ability and personally unknown to Mr. Mast; and as the notice is, in the opinion of thoroughly competent scholars, an honest and impartial criticism, I respectfully decline either to apologize for, or withdraw any part of, the article.

As, however, you seem to think—quite contrary to any ordinary reader—that the concluding paragraph refers to Mr. Mast personally, and not to his book, I have no objection to state in the August issue of the journal in question, that the strictures in the article had sole reference to the book and not to the author. More than this, in justice to my readers, I cannot do.

I am, dear sir, faithfully yours,
JOSEPH HUGHES.

9, Charles Square, Hoxton, N.
5th July, 1881.

MAST AND YOURSELF.

Sir,—Your letter of yesterday's date, in reply to mine to you of 2nd instant, herein is to hand; and as you decline to give the apology for the notice of my client's book in your periodical which he requires, and as you intimate that such notice was not written by yourself but by some other person, I must request you forthwith to furnish me with the name and address of the writer of such notice. Yours most obediently,

Mr. Joseph Hughes, ALFRED ASHLEY.
The PRACTICAL TEACHER Office,
Pilgrim Street, Ludgate Hill, E.C.

Pilgrim Street, Ludgate Hill,
London, E.C., July 6th, 1881.

Mr. Alfred Ashley,
9, Charles Square, Hoxton, N.

Dear Sir,—I am in receipt of your letter of the 5th inst., and in reply beg to state that Mr. Mast's complaint is so pre-eminently childish and ridiculous that I decline to enter into further correspondence on the subject. So far as I am concerned you must therefore consider this my final communication. I certainly shall *not* give you the reviewer's address. A copy of your letter of the 2nd and 5th inst. will be sent to him, and if he choose to reply thereto in the August issue of the PRACTICAL TEACHER, with additional strictures on the French book to substantiate his original critique—a course which I do not think he will hesitate to adopt—you will then know both the writer's name and address.

In conclusion, I think it but fair to you to state that I intend to print in my journal the correspondence which has passed between us. I am, dear sir,

Faithfully yours,
JOSEPH HUGHES.

9, Charles Square, Hoxton, N.
8th July, 1881.

Sir,—Your reply to my letter of 5th instant, enquiring the name, etc., of the writer of the article which so unfairly criticised and so grossly misrepresented my client's (Mr. Mast's) book, is to hand, and I cannot but express his and my own surprise at the tone of it, considering that he has such substantial cause of complaint against you for publishing as you have what is so injurious to the financial prospects of his work, and displays such a malicious bias to himself personally. As, however, I find that he has, previously to the receipt of such your reply to me, given you to understand that he will await the insertion in the next (August) number of your journal of what you have expressed yourself willing so to publish, he instructs me to say that, notwithstanding the objectionable character of such letter, he will delay taking proceedings until he sees what you may so publish, in hopes that, upon more mature reflection, you will see the justice of giving him the satisfaction which he is entitled to, by not only withdrawing all personal imputations upon himself, but by expressing your regret that the anonymous reviewer should have so unfairly misrepresented his book. Should this not prove to be the case, my client reserves to himself full liberty then to take such proceedings against you as he may be advised. Yours most obediently,

Mr. Joseph Hughes, ALFRED ASHLEY.
The PRACTICAL TEACHER,
Pilgrim Street, Ludgate Hill, E.C.

Trinity College,
Cambridge.

To the Editor of the PRACTICAL TEACHER.

Dear Sir,—You have been kind enough to allow me to peruse the correspondence which has passed between yourself and the solicitor of Mr. G. C. Mast, in reference to my review of a book entitled *French: Practice, Theory, and Notes*, with my opinion of which the said Mr. Mast is sorry to have to differ. As this is the case, and as the correspondence has taken the shape in which it now lies before your readers, namely, of a high-handed demand for an apology, I owe additional gratitude to you, sir, for offering me what is in some sense the privilege of reply.

In the first place with regard to Mr. Ashley's letters. He asserts that 'such criticism, from first to last, is calculated to hinder the future sale of my client's book.' This is, I suppose, meant as a compliment. It was certainly my aim to hinder the sale of the book, and Mr. Ashley asserts that I shall succeed. Thus far I have great pleasure in recording my agreement with him. But when he states that I intend to hold up Mr. Mast in person to ridicule, I must differ at once. I confess, and may the Fates forgive me for my ignorance, that up to my receipt of this remarkable manual I was entirely unconscious of the existence of Mr. Mast—much more so, of any enmity against him. Probably he was equally unconscious of mine, that is not at all to the point. I do protest that the world is large enough for us to be able to move frictionlessly among each other as far as such pitiable animosities are concerned. But the case is entirely altered when Mr. Mast becomes a public character. As far as his own disposition is expressed in his book, I am at liberty to quarrel with that disposition, but it is not likely that any large fraction of Mr. Mast's real self will appear in a French Grammar. If it does, as I say, I may rationally take exception to it. If not, nothing but insanity can persist in the claim that my remarks were personal. In a sense, however, I am brought into contact with the author himself. If a man poisons the water of a well, it is true that the chief business of the community is to see that the water is purified. It is also true that the community must, to put it mildly, get to know the man himself. Now, I am not going to assert that the well of French Grammar was pure and undefiled before Mr. Mast appeared on the scene. Such a statement were too wild, too obviously untrue and ridiculous. But I do think, to keep up the metaphor, that the man who adds poison to a well already not too pure is not wholly innocent. In this sense, and in this sense only, am I personally concerned with the author.

But Mr. Mast is far from being equally innocent with regard to me. All my actions are by him imputed to preconceived malice. All my criticisms, he opines, arise from irremediable ignorance. Not that, indeed, he has in any way disproved these criticisms. Far from it—he is wise enough not to attempt the impossible.

As I do most unhesitatingly affirm that my review was throughout just and unprejudiced, it is but right that I should a little substantiate my remarks by additional strictures and criticisms. I shall confine myself to the points I raised in the original review, and at the outset I will make one little admission. I did my poor best, but I confess that I have not succeeded in reading the whole book. For always at the fifth or sixth page of the conversational part I became aware of a sort of humming and drumming and buzzing in my ears. Perhaps it was a constitutional infirmity, I cannot say. Health compelled me to take the dish by instalments so infinitesimal that some is still left.

My attention has chiefly been devoted to the introduction, which Mr. Mast tells us is the latest heir of his invention. As such it should certainly be the best.

This introduction has two main objects:—

(1) To teach a number of French words by the resemblance in form between them and the corresponding English words;

(2) To teach the elements of French Grammar.

I will treat of these objects separately.

I submit, then, that the first is utterly ruinous and pernicious. In fact, though I have tried long, I hitherto have failed to see any possible good that can accrue to it. The results must necessarily be—

(1) To lead learners to infer similarity in other things beside mere form, such as meaning, gender, syntax, usage, commonness of occurrence, etc., etc.

This is so obvious as to need no further remark of mine.

(2) Unless all these lists are learnt by heart, the learner will unconsciously make false generalisations—finding for, instance, that almost every noun in the fifth and ninth list ends in *e* mute, that this list is headed 'Feminine,' or similarly that the eighth list comprises only nouns in *-tion* and *-sion*, he may be well excused for concluding that *-tion*, *-sion*, and *e* are distinctive Feminine endings, and that every noun with these terminations must be Feminine. It is true that Mr. Mast's third list (*a* and *b*) is of Masculine Nouns in *e*, but even this fact is not pointed out to the student, except at the place itself, while there is no conceivable chance of his forming reliable rules for himself from the materials here afforded.

(3) It affords false notions as to derivation. We are told that certain English words are derived from certain French words by various letter-changes which are dutifully mentioned. Ninety-nine learners out of a hundred would conclude that all these English words actually reached our language through the French. Let us take an example to illustrate our meaning, borrowing always from Mr. Mast's inexhaustible store—

imparfait and *imperfect*.

Is the ignoramus much to be blamed for concluding that *imparfait* was imported into our language, and our broad accent not being able to catch the exact sound, it was softened down to *imperfect*? We think not.

(4) These rules are so framed as inevitably to lead to the deduction and extension of the converse,

e.g., List 2nd.

The Rule is 'drop the accents and omit or add *e*.'

From âge	comes	age.
„ diadème	„	diadem.
„ problème	„	problem.
„ profil	„	profile.

We state that any child—and this book is primarily meant for children—would naturally reason thus—

age in English	becomes	âge,
∴ sage (the herb)	„	sâge,
page in English	„	pâge,
courage „	„	courâge.

Of course, he would not fall into all these mistakes *if* he thoroughly knew the previous word-lists, but we do not think it possible for children even to cram into their heads lists of some sixty words each *without any previous acquaintance* with the language.

Besides, there are certainly many other likely inferences of a similar sort for which Mr. Mast has no safeguard:—

e.g., problem becomes problème.
stem „ stème.

Ought the poor innocent to be caned for this?

(5) and lastly, under this head—Pronunciation. At this word, and the reference implied to the pages before us, we have a sort of inward shrinking.

We have given many specimens in our previous critique. We have great pleasure in reasserting their truth.

Take some more rules:—

'*h* always like in the English *hour*.'

This is bad English and worse French.

'*i* and *y* sound like *i* in *cabinet*.'

Really, before teaching French Grammar, Mr. Mast should devote some little attention to the uses of adverbs, and not favour us with such vulgarisms as this use of 'like.'

To this last rule a note is appended which partially but not wholly removes the difficulty. We are told that *i* has a long sound in *ige*, *ime*, *ice*. How about *ine*, *ite*, *ide*, etc., etc.?

'The *u* in *liquid* is not sounded.' Mr. Mast is certainly the first to discover that *q* by itself has any sound at all.

'Sound *signe* like *see-ng*, *gn* being pronounced in French like *ng* in *thing*.'

But we have given enough of such, *apropos* of our instalment in the review itself. They are pitiable specimens, taken almost at random. True, they are approximations to the truth, but equally true that they are failures, and were better unmade.

The second object of the said Introduction is to teach the elements of French Grammar. We submit that Genders are the *very basis* of grammar, and that we have already sufficiently proved Mr. Mast's complete failure in these.

To take one more instance merely. In the heading to the first word-list we read: 'The following sixty words in French are all names of male beings, or considered as males.' Of course every one who knows anything at all about the matter can see perfectly well what Mr. Mast means. But our author's very aim was to meet the requirements of those who know nothing at all about the matter. Let us watch, then, how this statement will act with them: *arsenic*, *canal*, *fruit*, *vase*, *vice*, *village*, are 'males.' Then we cannot but conclude that Frenchmen attach a meaning to 'male' altogether different to that which we attach to it. This is nonsense. The meaning of 'male' is axiomatic, and cannot differ in two languages. The truth is, our author's English is more in fault than his French. He might have easily stated that, with very few and well-marked exceptions, Latin Masculines and Neuters produced French Masculines, Latin Feminines, French Feminines. If he had done so, we should not have quarrelled with his list—as it is, we are bound to suspect that he has not himself clearly marked the fundamental distinction between the two words.

But, sir, I have already trespassed too much on your space—far more than the author had any right to expect.

I reassert every word of my former criticism. I cannot do otherwise, because I believe it the truth. I contend that I have shown that Mr. Mast, while unable to write English in the *third* edition of his book, is unable to teach French at any rate on paper. I contend that I have proved that in little points Mr. Mast is a very model of inaccuracy, and, as a corollary to this, I would urge that *little points*, *little inaccuracies*, are *infinitely more dangerous* than their larger brethren. I contend, too, that I have detected Mr. Mast in several serious mistakes amid this swarm of smaller ones. Finally, I believe the whole plan of the book utterly ruinous, even had it been perfectly carried out. I consider I have shown that it is not.

You will allow me, sir, as a sort of comforting farewell to this question, to quote from memory a passage of Lord Macaulay's affixed to the end of his criticism upon Mr. Robert Montgomery's poems, which had then passed through editions three or four times as numerous as poor Mr. Mast's prose. 'We are sorry,' he says, 'if our remarks give pain to Mr. Robert Montgomery. Such was not our intention. But at all cost to individuals literature must be purged.' And much else to the same effect.

I am sorry if my remarks give pain to Mr. Mast. But French grammar is stained enough. Mr. Mast must therefore excuse my feeble attempts to remove one or two of these eyesores.

Again thanking you, sir, for your kindness,

I am, dear sir,

Yours very sincerely,

THE REVIEWER OF MAST'S 'FRENCH THEORY AND PRACTICE.'

July 12th, 1881.

The writer of the last letter will be as much astonished as Mr. Mast when he finds his name omitted. It was his express wish that it should be printed. And we should have printed it, if Mr. Mast had not invoked the aid of the law. Now that he has retained the services of Mr. Ashley, and wasted hours of our time which we could ill spare, we decline to give it, unless he apologizes for his conduct, in which case we shall be happy to place the information at his disposal. Had Mr. Mast kept the promise he made in the presence of his publisher, he would have had a thoroughly satisfactory letter from the writer with his name and address. Probably he will have learned ere now that no childish ebullition of temper will deter us from doing our duty.

—o—

Publications Reviewed.

Marcus Ward's 'Improved Writing Copy-Books.' In 12 parts. (London: M. Ward and Co.)

It is quite evident that no expense has been spared in the preparation of this series of copy-books. The paper is all that could be desired, and the lithographing is easy and graceful, and of uniform style throughout.

Opening No. 1 of the series we find much the usual style of copies, but these are in *half-text*—a decided mistake, in our opinion. After many years of careful observation we make bold to state that it is a fallacy to suppose that young children are unable to obtain a sufficient grip of the pen in writing *large hand*. Now in turning to No. 2, we find that the author actually gives such letters as the *f* (in small-hand style), *g*, *y*, *j*, with inordinately long loops, which are much more difficult for the beginner than letters, say of a *medium* large hand, not going above or below the double line. Our experience has been that when beginners start between narrow lines, it leads to a scratchy style of writing, ill-shapen letters, and down-strokes of the same thickness as up-strokes. We believe it to be most important that the beginner should learn to make a firm down-stroke, but the copies of the early numbers of this series have such slight down-strokes and are so small that it will be a difficult matter to give the children a good style at the beginning.

The *graduation* of the copies is good and natural as far as it goes, but it proceeds too rapidly, *e.g.*, in No. 2 we get long loop letters such as the *f*, *y*, *g*, which should have been reserved, at least, till No. 3. A child is unable to make such letters at all well until he has written several books.

In most series of copy-books now published, a dotted middle line is given to teach the children how to form such letters as the *n*, *m*, etc., taking each up-stroke from the middle line. This middle line may also be utilized in pointing out where to commence the letters, *o*, *a*, *c*, etc., but this feature is entirely wanting in this series of copy-books. Dotted letters to be traced over by the children might also have been more freely used in the earlier numbers.

No. 6, the first, and the only book containing double-lined small hand, being intended for young children, should certainly have had dotted lines separating the words of the copies, as it is too much to expect children at this stage to arrange their work evenly on the page. Of course in the last numbers of a series these aids should be dispensed with. But for this minor fault this number would be an excellent one. The author of these books is to be congratulated on his happy choice of copies for Nos. 5, 6, and 7. They are mostly useful proverbs in common use. The insertion of one, however, rather surprised us, 'Marry in haste, repent at leisure.'

More variety should have been given in the double-lined books, No. 6 being the only one of the series. Another desideratum is practice for young children in the mode of setting down sums. This useful and important feature is entirely lacking in this series.

One of the greatest defects of these copy-books is the style of writing in Nos. 8 and 9, the last of the set. It is too small, flabby, and utterly lacking in character. The copies in No. 8 consist of judiciously-selected extracts

from Shakespeare of two or three lines on each page, and No. 9 contains the usual Commercial Forms and Correspondence.

No. 10, 'Lettering, plain and ornamental,' is a model number in every respect; in fact, it is the best we have seen.

No. 11 is a useful blank exercise-book for transcriptions, dictation, etc., and No. 12, the last of the series, is likewise a blank exercise-book, but cross-ruled, so that it can be used by beginners for setting down sums. The squares are much too small; indeed, they should be almost half as large again to afford sufficient space for round, bold figures.

A few words in conclusion. This series of copy-books would be an excellent one if the copies of the first three or four numbers were larger and those of the last two numbers were rounder and bolder. If a teacher desires a uniform and good style of writing in his school, he should select the series best adapted to teach a bold, legible hand, and then use it exclusively. We have tried the experiment of selecting the best numbers from several series of copy-books, and found the result most disappointing, no two scholars writing the same style of hand.

The National Method of Vocal Music. By W. W. Pearson. (Manchester: Heywood. London: Simpkin and Marshall.)

No book suffers from modesty of title, but we question whether the pretentiousness of the title of Mr. Pearson's book is calculated to disarm criticism. We should have preferred some such title as *An Introduction to Vocal Music* as more truly descriptive of the book. Mr. Pearson, in fact, aims at eliminating all the 'keys' of music except the natural one of C, and proposes transposing all music into the key of C, retaining the old or established notation. Of course, so far as vocal music is concerned, the alteration of *pitch* will be readily effected, or rather the practical accommodation of the key of C to any variety of pitch will be easy. Herein Mr. Pearson treads on Hullah's lines in the first portion of his system. But it was made a complaint against Hullah's system that pupils remained in the key of C, and were unable to feel their way with certainty out of it. Mr. Pearson proposes that they shall never attempt to get out of it by presenting all music to be sung in this key. It may be a question how far the exclusive use of the key of C is to be recommended for pupils in elementary schools; but, granting its expediency, it is altogether another question to call this elimination of all but one key a National Method. It may further be questioned whether the *Do, Re, Mi* syllables, which are at the foundation of all the difficulty, need be retained. However, the subject has become so complicated as to leave but little hope of common agreement.

We therefore leave the theoretical to notice the manner in which Mr. Pearson has arranged his lessons. Here we cannot help noticing that Mr. Pearson seems to regard words as more important than things. He is elaborately minute in carrying on time exercises by beating in the *d, l, r, u* method, which we regard as unessential compared with familiarizing the mind with the unceasing mechanical swing of the time, and associating this with the note in question by the most simple processes of counting and beating—the more simple the better. The having to call to mind the *names of the notes* is a needless diversion of the mind from its main object. Leaving these preliminary time lessons, we have some pleasing exercises on the intervals of the scale, but in which the alphabetical names of the notes are completely ignored; these are, in fact, never mentioned throughout the book. The remainder of the book is chiefly occupied by a number of pleasing and accurately-written two-part songs, with several rounds in three or four parts, amid which the main points of musical expression, rates of time, and other details are judiciously introduced and exemplified. The Minor Mode is conspicuous by its absence. The Tonic Sol-Fa expedient of altering the names of the syllables on the introduction of accidentals is carried out, and the use of a host of fresh terms thereby involved. This new nomenclature, however, is not thoroughly carried out. We are introduced to MI-FLAT, but relegated to RE-SHARP, RE-FLAT, and LA-SHARP. All this is retrograding rather than progressive —rendering music more difficult rather than simplifying it. We would not quarrel with any introduction, however simple, to elementary music; but while we find in Mr. Pearson's book the real difficulties of music avoided or evaded, we regret to find such easy matters as time and the relative value of notes encumbered with needless technicalities.

The book is clearly printed, and remarkably free from errors. A few hymns are added at the end in two-part harmony.

Songs after Sunset. By Joseph S. Fletcher. William Poole, Paternoster Row, E.C.

The twelve short poems in this pamphlet give evidence of another true poet rising up amongst us. It is understood that he is quite a youth, aspiring—and not vainly— to raise himself through literature; in fact, he has already published a small volume, entitled *Juvenile Poems*, which so eminent a judge as Lord Houghton has favoured with his praises. Mr. Fletcher reminds us in several places both of Tennyson and of Swinburne; particularly of the latter in that sensuous and passionate poem, 'Endymion on Latmos.' Tennyson's special *In Memoriam* rhythm (though Marlowe used it before him) is more than once reproduced; as are also touches of Maud, etc., in these 'Songs,' whereof 'In the Garden' is a very favourable specimen, full of the enthusiasm of young love, and altogether a very charming lyric. As, however, our space is limited, we can only give at length, as perhaps the gem of the booklet, the following :—

A VALEDICTORY POEM.

And what are these, and what am I
  That I should dare to sing aloud
Beneath this cold and cloudy sky,
  And to this nineteenth-century crowd?
Is this a time for rhyme and song,
  Is this the place to stand and sing,
Where all men pass in haste along
  And have no thought for such a thing?

Ah, it would rather fitter seem
  To sail away o'er mystic seas,
And dream and think, and think and dream
  Beside the sweet Hesperides.
Or yet to seek that ancient land
  Where runs the fountain Hippocrene,
Until uprose the glorious strand,
  And all the flashing isles between.

And that were sweet, for there the hours
  Should pass away from eve to morn
Among the bright Thalian flowers,
  And all the nymphs and satyrs born
Of mirth and song should troop around
  From rock to rock, from tree to tree,
And to the dear enchanted ground
  Should come the Muse Calliope.

For surely that were better far
  Than still beneath this sky to stay
Among the frozen times that are,
  And rhyme it out from day to day
With ne'er a word of thanks or grace,
  But in their stead unblushing sneers
Laughed forth from some unlettered face
  Which never knew the touch of tears.

O silence, and forget them all,
  And think of what thy life must be,
And know what now seems bitter gall
  May some time taste most sweet to thee.
And though no praise or thanks be thine,
  Still go upon thy unknown way,
And tell the things that are divine
  To all and each from day to day.

Behold, no being ever stood
  Upon this earth but that it bore
Some message or some word of good
  In all degrees from less to more;
And thou hast thine. Go onward then,
  Until thy deeds and words have shown
A love to all thy fellow-men,
  And made thee worthy of their own!

Primer of the Industrial Geography of the United States. By G. Phillips Bevan. London: Swan Sonnenschein, and Allen.

This forms one of the Industrial Geography Series, in which Great Britain and France have already been treated. We opened this little primer with the expectation of finding the industrial and other leading features of the United States well and carefully described, and are in no way disappointed. In some seventy or eighty well-written pages we have a succinct yet far from meagre account of the natural productions, manufactures, traffic routes, ports, and principal cities of the States, together with the main causes, where traceable, of the location of such industries. The information is brought down in most cases to the present time, and the progressive development of many manufactures traced. Of course the book contains much statistical information, and is adapted to pupil teachers and advanced standards; but to these it will be invaluable. Speaking of the cotton manufacture, the author says: 'It might be reasonably expected that as the cotton crop is essentially a Southern one, the bulk of the cotton manufactures would be found in the same States; but it is not so, the Northern States contain the great majority of the cotton-mills. The reason of this has been, that the formation of the country with rapid streams issuing from the hills, is more favourable to the providing of water-power than the slow, sluggish rivers of the South, added to which the conditions of the atmosphere in the North are also better suited to cotton-spinning.' We should like to see most facts bearing upon industrial geography thus explained that are capable of explanation. The enormous development of the American provision trade since we have allowed all articles of food free entry to our shores is very surprising, and forms the subject of an interesting chapter. In this the rapidly increasing trade in canned food is interestingly sketched. In this trade Chicago enters so largely that one firm makes up 50,000 cans daily, and no less than 300 oxen are killed and dressed in the day to make up supplies of beef alone. A useful summary or table of industries is given for reference at the end.

Stewart's Geographical Reading Books. For Standards II., III., IV., V., and VI. W. Stewart & Co., Holborn Viaduct, London.

If children do not learn geography it will not be for want of a number of text-books. In addition to these, we may add the more or less systematic treatment of the subject in the way of reading lessons, as recommended by the Code for 1880. Few subjects admit of being thus treated more advantageously than geography, associated as it is with the political and physical matters of every country of the globe, and affording scope for lively descriptions of scenery, people, animal and vegetable life, and remarkable natural phenomena. When we add to these the causes that may be assigned for many facts, the plain deductions that may be drawn from others, we have shown that here is an ample field for interesting as well as instructive reading. The series before us begins at Standard II. This introductory book is written in a style suitable to the class of readers for which it is intended, but we are disposed to question the advisability of placing the mass of the lessons treated of in this first stage as introductory subjects. The little scholar is first to read about the size, shape, and motions of the earth, the points of the compass, latitude and longitude, and other matters connected with lessons on the globe. These, we think, would wisely be deferred till a few details were given appealing to home observation, such as make up most of the subject-matter of the book for Standard III. In fact, we should simply change the order of these two books.

This book for Standard III. begins with some very pleasing lessons on *A Walk into the Country*, and then gives a familiar description of the principal features of England, commencing with a graphic description of the coast line. In this some inaccuracies occur. P. 48, 'The coast line (of Sussex) continues bold and rocky till we arrive off Selsea Bill.' Now the Sussex coast is remarkably flat from the sudden termination of the cliffs at Hove (West Brighton), thence by Shoreham, Lancing, Worthing, Goring, Little Hampton, and so on to the almost sudden bluff of Selsea Bill. 'Crossing the mouth of the Thames (from Essex) we arrive off the coast of Kent, which is for the most part low and marshy.' Many will stare at this, who remember the heights of Dover, and the extent of the other chalk hills of the Kentish coast. 'But as we skirt the coast of the island of Sheppey, we notice high cliffs from fifty to eighty feet in height.' Now the Sheppey cliffs begin about a mile eastward of Sheerness, and suddenly attain a height of nearly 300 feet, which they maintain till their equally sudden descent at Warden. 'The Cotswold Hills take their name from the ancient sheep "cots" found on the wolds or hills,' p. 76. It is time this misleading etymology was abandoned. By a glance at Welsh or Celtic roots that form many of our place-names, it will be found that *Cotswold* is from the Welsh *coed*, a wood, and the Teutonic *wold*, of similar meaning. This is one out of many examples that we have of duplication of meaning in place-names. Equally wrong is the attributing the world *combe*, a valley, to the Saxons, it being a decided test word of the presence of the ancient Britons, and is very rarely found where the Saxons, Angles, and Jutes predominated.

Standard IV. takes us on the whole agreeably through Asia, Africa, and America. In this book we are treated to no less than four full-page illustrations of snakes, and in one of which the common viper is represented as equal in size to the formidable boa.

For Standards V. and VI., one book, devoted to a somewhat advanced description of Europe, is appropriated. In this we have methodical descriptions of the principal physical and political features of the countries of Europe, with the most striking characteristics of the people. With due attention to the useful summaries at the end of each chapter, together with the use of maps in the suggested oral lessons, the pupils who go through these thoughtful and attractive volumes cannot fail of gaining a fair and pleasantly acquired knowledge of the main features of geography. The illustrations of these four books are numerous, good, and in almost all cases appropriate. We might take exception to the pilchard being represented larger than the herring (p. 116), but with so much to commend, we are not inclined to be hypercritical.

The Church Choir Manual. Edited by Edwin Potter. (London: Rivingtons.)

This is a collection of preces and responses, kyries, litanies, and doxologies, that will doubtless be useful in many churches where full musical services are not used, yet where the prayers are intoned, and the responses sung generally in a harmonized form. The first

ferial versicles are arranged from Merbecke, and correctly harmonized. This is followed by a setting of Gregorian versicles. Next comes Tallis's ever-popular preces and responses, under the head of Festival Versicles. To this follows a monotone setting of the Litany, by the editor, to which the accompanying harmonies are chaste and suitable. Tallis's litany follows, and then follow a selection of kyries. In these there are signs of less careful writing than in the other portions of the book. We hardly like the following, by Sidney Naylor :—

We don't like the free-and-easy resolution of the seventh in bar 1, nor the skips to perfect concords between the alto and tenor in bar 2, and have a greater dislike to the flagrant consecutive fifths between the treble and tenor in bar 3. This disregard of the most important rule in harmony again occurs, thus :—

Surely there are plenty of good specimens of kyries—almost as common as chants—to be had without printing such crude and incorrect stuff as this. In ecclesiastical music, more particularly in that arranged in the usual four-part harmony, we have at least to ask for accuracy, and this seems to be disregarded in many of the examples collected by Mr. Potter. A page of glorias (doxologies) concludes this little collection, which, with the re-writing, or at least thoroughly carefully harmonizing, of the carelessly-written kyries, would be welcome to most choirs. We ought, however, to mention that the book contains several remarkably good kyries—some by Dr. Westbrook, written with his usual taste and accuracy.

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Query Column.

*** *Communications for this column must reach the Office not later than the 15th inst., and should be addressed,* 'THE QUERY EDITOR' of the *Practical Teacher*, Pilgrim Street, Ludgate Hill, London, E.C. *Correspondents must in all cases remember to give their true names, not necessarily for publication, but as a guarantee of good faith, and for facility of reference.*

We are now receiving such a number of Queries that we shall be obliged for the future to limit each correspondent to ONE *question. When more than one are sent, we shall, if possible, give slight hints for the solution, or solve the most difficult only. All, however, who adhere to our rule may be sure of having their difficulties fully explained.*

We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

1. PERCY ALEXANDER, Leeds.—If a six-sided figure have its opposite angles equal, prove that its opposite sides are parallel.

Let ABCDEF be the hexagon. Join AC. Then we have that DCB = AFE, CBA = FED, BAF = EDC.

$\therefore$ DCB + CBA + BAF = $\frac{1}{2}$ (sum of angles of hexagon).

But by I. 32 we have that the sum of the angles of the hexagon + 4 rt. angles = 12 rt. angles.

$\therefore$ sum of angles = 8 rt. angles
$\therefore$ DCB + CBA + BAF = 4 rt. angles ;
But ACB + CBA + BAC = 2 rt. angles
$\therefore$ DCA + CAF = 2 rt. angles
$\therefore$ CD is parallel to AF, etc.—Q.E.D.

2. A. E. HODGSON, Leeds.—BAD is a triangle having a right angle at A, AC is perpendicular to BD, AC = 8, BC = 3, find AD and BD. (*Irish Commissioners' Mensuration.*)

By Euclid VI. 8.

$$AC^2 = BC, CD \quad \therefore CD = \frac{AC^2}{BC} = \frac{8^2}{3} = \frac{64}{3} = 21\tfrac{1}{3};$$
$$\therefore BD = 21\tfrac{1}{3} + 3 = 24\tfrac{1}{3}.$$

Also by the same proposition

$$AD^2 = DC, DB = \tfrac{64}{3}\{\tfrac{64}{3} + 3\}$$
$$= \frac{64 \times 73}{3^2};$$
$$\therefore AD = \tfrac{8}{3}\sqrt{73}$$
$$= \tfrac{8}{3}\{8{\cdot}5440039\}$$
$$= 22{\cdot}7840104.$$

3. J.E.R., Dudley.—Your questions would receive more satisfactory answers than we could possibly give if you were to apply to the Head Teacher of the nearest Public Elementary School.

4. CŒUR DE LION, Leamington.

Simplify

$$\tfrac{1}{6}\{x(x+1)(x+2) + x(x-1)(x-2)\} + \tfrac{1}{3}x(x+1)(x-1).$$

Exp. $= \tfrac{2}{6}\{x^3 + 2x\} + \tfrac{1}{3}x(x^2 - 1)$
$= \tfrac{1}{3}\{x^3 + 2x + 2x^3 - 2x\}$
$= x^3.$

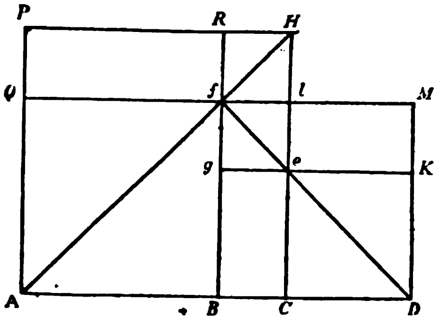
This entirely disagrees with the answer you give. There must be a misprint or a mistake somewhere.

5. W. H. G., Grimsbury.—You may obtain a copy of the London Matriculation Regulations, post-free, on application to

The Registrar,
University of London,
London, W.

Your other question, in which you give thirteen words of which you want the complete history, we must leave unanswered because of the space it would need. All the information you require may be got from Wedgwood's *Etymological Dictionary*, which you will find in any good reference library.

6. LOUIS, Dundee.—Prove Euclid II. 9 by a demonstration similar to that of the preceding eight propositions.



Let AD be the given line, bisected in B, and divided into two unequal parts in C.

On AC describe the square APHC.

Join AH.

Draw BFR parallel to CH, meeting AH in F.

Draw through F, QFLM, and through E, GEK parallel to AD.

Then by II. 4 Cor. and various easy deductions which it is unnecessary to transcribe.

QABF, RFLH, FGEL, ECDK are all squares, and therefore RL = EF.

Now the rectangle PF = FC = FK being complements of the parallelograms about the diagonals of their respective squares

Hence sq. PC + sq. ED
= QC + ED + FK + RL
= QD + 2EF
= 2QB + 2EF
= $2AB^2 + 2BC^2$, which is Euclid II. 9.

7. 'DIEU ET MON DROIT,' Chobham.—A merry young fellow in a short time got the better of one-fifth of his fortune. By the advice of his friends he gave £2200 for an Exempt's place in the Guards; his profusion continued till he had no more than 880 guineas left, which he found, by a computation, was $\frac{3}{20}$ of his fortune. What was the original amount?

The greater part of this question is certainly most unnecessary padding. Stripped of all this, the question becomes $\frac{3}{20}$ths of a man's property is £924; what is the property?

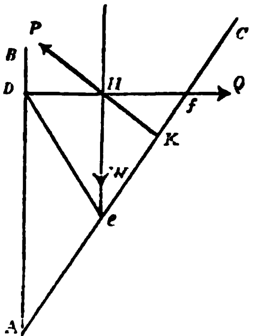
Evidently $£\frac{20}{\cancel{3}} \times \frac{308}{\cancel{924}} = £6160$.

8. 'DIEU ET MON DROIT' also sends us ten words to *parse fully*. If he is astonished at our not answering his request we can only refer him to *Query Column* for this month, *Italic Notices*, and answer to *Query* 5.

9. With respect to his writing also, on which he would like our opinion, we may remark that it shows signs of promise. Write faster and acquire a business style, otherwise you will never write *really well*.

Though it is a work of supererogation, we feel bound to point out that 'beleive,' and 'on My Writing,' etc., etc., leave evident room for improvement.

10. DOUGLAS LEESE, Newton Abbot.—Draw a vertical line AB, and a line AC, making an angle of 30° with it; place an equilateral triangle DEF, of weight W, between these lines with one angle on AB, and the other two on AC. Assume that the surfaces are smooth, and find the pressures on AB, AC.



In the figure we have DAE = 30°, DEA = 180° − 60° = 120° ∴ ADE = 30° ∵ by I. 32 the sum of the three angles is 180°, and EDF = 60° ∴ ADF = 90°. Hence DF is the line of action of Q, the resistance of the vertical wall AD. Hence also it follows that the triangle is symmetrically placed as in the figure, and that EH, the vertical through the centre of gravity of the triangle bisects the base. Let EH meet the base in H. Then, since the system is in equilibrium, the lines of action of the forces acting upon it are concurrent. Therefore the third force, the resistance of the wall AC passes through H. Hence HK, perpendicular to AC, represents this, since all surfaces are smooth. Thus we have P, Q, and W acting at H. Now EHF = 90°; EHK = 90° − HEK = 90° − 30° = 60° ∴ PHF = 150° ∴ PHE = 120°. Also, since P, Q, W are in equilibrium,

$$\begin{array}{llll} P : Q : W & :: \sin \widehat{QW} & : \sin \widehat{WP} & : \sin \widehat{PQ} \\ & :: \sin EHF & : \sin EHP & : \sin PHQ \\ & :: \sin 90° & : \sin 120° & : \sin 150° \\ & :: \quad 1 & : \quad \frac{\sqrt{3}}{2} & : \quad \frac{1}{2} \\ & :: \quad 2 & : \quad \sqrt{3} & : \quad 1 \end{array}$$

11. EDWAL, Treffgarne, R.S.O.—We advise you to get more advanced books. For Latin Grammar and Syntax:—*Student's Higher Latin Grammar* (Murray), 7s. 6d.; Abbott's *Latin Prose through English Idiom* (Seeley), 2s. 6d. For Greek Grammar and Syntax:—Parry's *Greek Grammar* (Longmans), 3s. 6d.; Farrar's *Greek Syntax* (Longmans), 4s. 6d. For French Grammar, etc.:—Breymann's *Grammar* (Macmillan), 4s. 6d. You seem to place rather too much reliance in Ahn's books. Do as much translation as you can.

12. J. D. ROWE, Dunstable.—Two boys, A and B, start together from the same point, and walk round and round a ring fence in opposite directions till they meet exactly at the starting-point; their last meeting-place before this having been 990 yards from it. A's rate is to B's as 5 : 3. Find the distance covered by each. We venture to think the following an improvement on the method you adopt:—A obviously walks five times round while B does three. Suppose that the course is x yards in length; then we have two interpretations depending on whether the 990 yards is measured in the direction in which A is going, or in that in which B is going. In the first case A has 990 yards, B has $x - 990$ yards to do, when they last meet, and as they do this in the same time,

$$3 \times 990 = 5\,(x - 990) \quad \therefore x = \frac{8 \times 990}{5} = 1584$$

$\therefore$ A altogether walks 7920 yards.

In the second, suppose 990 yards is measured in B's direction—

$$\text{Then } 5 \times 990 = 3\,(x - 990)$$
$$\therefore 3x = 8 \times 990$$
$$x = 8 \times 330 = 2640$$

$\therefore$ A walks $5 \times 2640 = 13{,}200$ yards.

B walks, in the two cases, 4752, and 7900 yards.

Neither of these answers agree with yours. We are yet audacious enough to believe them a nearer approach to the truth. The method is not so tentative.

13. AMICUS, Leeds.—Solve the equations

$$\left.\begin{array}{l} x + 71y + 53z = 400 \\ 3x + 73y + 51z = 401 \\ 19x + 89y + 35z = 408 \end{array}\right\}$$

(*London Matriculation*, June, 1881.)

Subtracting the first of these from the second

$$2x + 2y - 2z = 1$$
$$x + y - z = \tfrac{1}{2}$$

Subtracting the second from the third

$$16x + 16y - 16z = 7$$
$$x + y - z = \tfrac{7}{16}$$

But these equations are inconsistent, inasmuch as $\underline{x + y - z}$ cannot be simultaneously equal to $\frac{1}{2}$ and $\frac{7}{16}$.

Hence the original equations were inconsistent with each other.

(N.B. It is not an uncommon thing to find these in Matriculation Papers. They are meant as catches, of course).

14. J. D. M., Weston-super-Mare.—I have a bill in my possession of £600, which is due in 6 months. If I get it cashed now the bankers will charge me 5 per cent., but if I wait for 3 months I shall be able to get it discounted at $3\frac{1}{2}$ per cent. On all money that I have in my business I am able to make 6 per cent. per annum profit; would it be prudent in me to cash the bill at once, or wait till I can get it done at the lower rate? If so, how much should I gain or lose?

Present worth of

$102\frac{1}{2}$ for 6 mos. at 5% is 100

1 ,, ,, ,, $\cancel{\frac{100}{102\frac{1}{2}}} = \frac{40}{41}$

£600 ,, ,, ,, $£\frac{40 \times 600}{41}$

Now this money is supposed to be put out in the business for a quarter of a year at 6%. It thus becomes $\frac{101\frac{1}{2}}{100}$ of its former

value $\therefore$ result is $\frac{203}{\cancel{200}} \times \frac{\overset{120}{\cancel{24000}}}{41} = £\frac{24360}{41}$

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41)24360(594  2  11 8/41
   205
   ---
    386
    369
    ---
     170
     164
     ---
       6
      20
     ---
     120
      82
     ---
      38
      12
     ---
     456
      41
     ---
      46
      41
     ---
       5
```

This, then, is the amount if the first course is adopted.

In the second course the bill lies idle for a quarter of a year, and is then cashed at $3\frac{1}{2}\%$.

Present worth of $100\frac{7}{8}$ for $\frac{1}{4}$ year at $3\frac{1}{2}\%$ is 100

$$
\begin{array}{llll}
1 & ,, & ,, & \frac{800}{807} \\
600 & ,, & ,, & £\frac{800 \times 600}{807}
\end{array}
$$

On simplification this last becomes £594 15s. $10\frac{750}{807}$d., so that it is the better course to keep the bill by about 13s.

[We are sorry to differ so considerably from the answer you give. Perhaps we have interpreted the sum differently.]

15. J. D. M. also kindly points out a mistake, which we notify at the end of this month's *Query Column*.

16. ALPHA, Bristol.—The abscissa and double ordinate of a parabola are h and k, and the diameters of the circumscribed and inscribed circles D and d. Prove that $D+d=h+k$.

[Please do phrase your problems more definitely. It is really hard to say what you mean, and wastes much of our time.]

As we take it, PNP^1 is double ordinate, and A the vertex. By the inscribed circle we can only mean the circle touching the parabola and A and PNP^1 at N. If this be the case, $d = h$.

By the circumscribed circle the circle touching the parabola at A and passing through P and P^1

If this be the case, $\left(\frac{k}{2}\right)^2 \quad h(D-h)$

And as it is clearly impossible for D to equal k except in the special case in which k is $a + h$, the theorem cannot be true.

Do you mean d to be the diameter of the circle inscribed in the triangle PAP^1?

In this case $d = \dfrac{2hk}{k + \sqrt{k^2 + 4h^2}}$ $\quad D = \dfrac{k^2 + 4h^2}{4h}$

and $d + D$ is not equal to $h + k$ except in a particular case.

We give up the riddle.

17. ALPHA, Bristol.—The vertex of a parabola is taken for the centre of a given :— show that the equation of a straight line touching both circle and parabola is

$$y = mx + r\sqrt{1+m^2} \text{ where } m = \pm\left(\frac{\sqrt{4d^2 + r^2} - r}{2r}\right)^{\frac{1}{2}}.$$

Here again you are indefinite. What is r, what is d?

On the natural assumption that d is what is ordinarily known as a, we reason as follows :—

Any st. line touching circle radius r and centre at origin has an equation

$$y = mx + r\sqrt{1 + m^2}$$

Any st. line touching the parabola an equation

$$y = mx + \frac{a}{m}$$

$\therefore$ if a st. line satisfies both conditions

$$r\sqrt{1 + m^2} = \frac{a}{m}$$

$$\therefore r^2(1 + m^2)\, m^2 = a^2$$

$$r^2m^4 + m^2r^2 - a^2 = 0$$

$$m^2 = \frac{-r^2 \pm \sqrt{r^4 + 4a^2r^2}}{2r^2}$$

$$m = \pm\left(\frac{\sqrt{4a^2 + r^2} - r}{2r}\right)^{\frac{1}{2}}$$

We really cannot give any attention to your third problem. You have had more than your share of our space already.

18. THOMAS LIDDEL, Pontypridd.—In a triangle ABC, AD being drawn perpendicular to the straight line BD which bisects the angle B, show that a line drawn from D parallel to BC will bisect AC. (Pott's *Euclid.*)

Suppose the line EDF which is drawn through D parallel to BC meets AB in E and AC in F;

Then the angle EDB = DBC = EBD $\therefore$ ED = EB. Describe a circle with centre E and radius EB or ED. Then this circle passes through A, for if not let it meet BA in A^1. Then A^1DB being the angle in a semicircle, is a right angle. But ADB is a right angle, etc., etc. Hence A, D, and B lie on a circle with centre E $\therefore$ EA = EB $\therefore$ AF = FC since EF is parallel to BC.

19. PUPIL TEACHER, Hull.—A person has £2950 in the 3 per cents. at $83\frac{1}{3}$. When the funds have fallen $2\frac{1}{3}$ per cent. he transfers his capital to the 5 per cents. at 108; find the alteration in his income. (Barnard Smith, *Arithmetic.*)

In the 3 per cents. £100 stock produces £3

$$\therefore £2950 - £\tfrac{3}{100} \times 2950$$

$$= £\frac{59 \times 3}{2}$$

$$= £88 \text{ 10s.}$$

After the funds fall $2\frac{1}{3}$ they are at 81.

Hence £2950 stock is worth £$\frac{81 \times 59}{2}$ cash.

In the second stock £108 cash produces £5

$$\therefore £\frac{81 \times 59}{2} \quad ,, \quad £\frac{\cancel{105} \times \overset{3}{\cancel{81}} \times 59}{2 \times \underset{4}{\cancel{108}}}$$

$$= £\tfrac{885}{8}$$

$$= £110 \text{ 12s. 6d.}$$

$\therefore$ the change in income is £22 2s. 6d.

20. TRIGON., Langley Mill.—If $x+a$ be the G.C.M. of x^2+px+q, and $x^2+p^1x+q^1$, show that $a = \frac{q-q^1}{p-p^1}$.

Since $x+a$ divides x^2+px+q, x^2+px+q vanishes when $x+a = 0$, *i.e.*, when $x = -a$

$$\therefore a^2 - ap + q = 0$$

$$\text{Similarly } a^2 - ap^1 + q^1 = 0$$

Subtract these results and we get at once $a = \frac{q-q^1}{p-p^1}$.

[Your other question must be omitted, see rules.]

21. F.S., Romford.—Find a number of 6 digits with 7 in the unit's place such that when the left-hand figure is removed to the right hand, the number thus formed is equal to three times the original number. (*Civil Service*, Jan., 1879.)

The number is 142857. To show the reasons for this choice it is necessary to convert $\frac{1}{7}$ into a circulating decimal, $\frac{1}{7} = \cdot 1\frac{3}{7}$, $\frac{3}{7} =$ (multiply) $\cdot 4\frac{2}{7}$, $\frac{2}{7} = \cdot 2\frac{6}{7}$, etc., etc.

Hence $\frac{1}{7} = \cdot\dot{1}4285\dot{7}$

From the method of obtaining this result we see at once that

$$\tfrac{2}{7} = \cdot\dot{2}8871\dot{4}$$

$$\tfrac{3}{7} = \cdot\dot{4}2857\dot{1}$$

$$\tfrac{4}{7} = \cdot\dot{5}7142\dot{8}$$

$$\tfrac{5}{7} = \cdot\dot{7}1428\dot{5}$$

$$\tfrac{6}{7} = \cdot\dot{8}5714\dot{2}$$

the same figures being used throughout and in cyclical order. The same rule applies to many other decimals, such as those for $\frac{1}{17}$, $\frac{1}{19}$. A careful study of similar questions will enable you to do most of them by this method.

22. W. E. F., Rotherham.—If 9 oxen are kept for the same money as 7 horses (for any given time), and a team of oxen are $\frac{1}{5}$ as long again in ploughing 97 acres as the same number of horses are in ploughing 90 acres, and a field costs as much whether ploughed by oxen or horses, viz., £7 5s. 6d., the same number of men being required in both cases and being paid by the time, what is due to them? (Colenso, *Arithmetic.*)

While the oxen plough 97 acres

the horses ,, $\frac{6}{5} \times 90 = 108$ acres;

$\therefore$ the men's wages in the two cases are as 108 to 97.

Also the keep of the animals in the two cases is as

$$7 \times 108 : 9 \times 97$$

To keep our ideas clear, let us introduce the symbols m and k for the men's wages and animals' keep.

$$108m + 7 \times 108k = 97m + 9 \times 97k = £7 \text{ 5s. 6d.}$$

We have two simultaneous equations which become

$$m + 7k = \tfrac{97}{1440}$$

$$m + 9k = \tfrac{3}{40}$$

$$\therefore 2m = \frac{9 \times 97 - 3 \times 7 \times 36}{1440}$$

$$= \frac{97 - 84}{160} = \tfrac{13}{160} \qquad \therefore m = \tfrac{13}{320}$$

But the men's pay in the two cases is $108m$ and $97m$.

Hence the pay is £$108 \times \frac{13}{320}$ and £$97 \times \frac{13}{320}$ in the two cases, the first referring to when oxen do the business. We need not trouble to elaborate these answers. It will doubtless be objected that we have introduced algebra, but it must be remembered that arithmetical algebra is allowable here. Of course we could have dispensed with it, but the result would be much clumsier wording.

23. D. J. H., Airdrie.—Magnetism and Electricity will be dealt with in due time. We shall be glad if you will put your next communication into a stamped envelope, and not entail extra postage upon us.

24. An Ex-P.T., Torquay.—James Blackwood issues 'A Complete Practical Guide to Her Majesty's Civil Service,' and Crosby Lockwood issues books to the same effect. Consult your bookseller.

25. JOSEPH INGLIS, Peebles.—The sum of two numbers is 6, and the difference of their third powers is 56. Find the numbers.

Let x and y be the numbers,

$$x+y=6;\; x^3-y^3=56$$
$$\text{But } y=6-x \quad \therefore x^3-(6-x)^3=56$$
$$\therefore\; 2x^3-18x^2+108x-216=56$$
$$x^3-9x^2+54x-136=0$$
$$x^3-2x^2+7x^2-14x+68x-136=0$$
$$(x-2)(x^2+7x+68)=0$$
$$\therefore\; x=2, y=4;\text{ or, } x^2+7x+68=0$$
$$x=\frac{-7\pm\sqrt{49-272}}{2}=\frac{-7\pm\sqrt{-223}}{2}$$

We must, however, neglect impossible answers. This method would be allowable even in Simultaneous Quadratics. Indeed, for this sum there is no other.

26. SERMO, Arbroath.—The Scholarship Answers will include School Management.

27. JOSEPH MAWSON, Leeds.—Solve the equation—

$$\left.\begin{aligned}x^2+xy&=28\\ xy-y^2&=3\end{aligned}\right\}$$

From the second equation we have at once $x=\frac{3+y^2}{y}$. Substitute this value in the first $\frac{(3+y^2)^2}{y^2}+(3+y^2)=28$.

Put $y^2=z$, Then—

$$(3+z)^2+z(3+z)=28z$$
$$\therefore\; 2z^2-19z+9=0$$
$$\therefore\; z=\frac{19\pm\sqrt{19^2-8\times9}}{4}$$
$$=\frac{19\pm\sqrt{361-72}}{4}=\frac{19\pm\sqrt{289}}{4}=\frac{19\pm17}{4}$$
$$=9\text{ or }\tfrac{1}{2}$$
$$\therefore\; y=\pm3,\text{ or }\pm\frac{1}{\sqrt{2}}$$

Hence, at once, $x=\pm4$, or $\pm\frac{7}{\sqrt{2}}$

28. PUPIL TEACHER, Salford, refers to our answer to *Query No. 21, July*, as Algebra, whereas it should be Arithmetic. We did not know that this was the intention of the sender, for he certainly made no such statement. Certainly, in strictness the phraseology of the solution given is Algebraical, and as such might not be accepted by H.M.'s Inspector. But at the same time there is no Algebraical *principle* involved, and it would therefore be easy to adapt our words to Arithmetic.

29. W. GOUDIE, Derby.—In the expansion of $(1+x)^{2n}$ prove that the sum of the squares of the odd co-efficients differs from the sum of the squares of the even co-efficients by

$$\frac{2n\,(2n-1)\ldots(n+1)}{1\,.\,2\,.\,3\ldots\; n}.$$

$$\text{Let } (1+x)^{2n}=C_0+C_1x+C_2x^2+\ldots+C_{2n}\,x^{2n}$$
$$\left(1-\frac{1}{x}\right)^{2n}=C_0-\frac{C_1}{x}+\frac{C_2}{x^2}+\ldots+\frac{C_{2n}}{x^{2n}}$$

$\therefore\; C_0^2-C_1^2+C_2^2-\ldots+C_{2n}^2$ is equal to the co-efficient of x^0 in $(1+x)^{2n}\left(1-\frac{1}{x}\right)^{2n}$; *i.e.*, of x^{2n} in $(1-x^2)^{2n}$

i.e., it is equal to $(-1)\,\frac{2n\,(2n-1)\,\ldots\,(n+1)}{1.\;\;2.\;\;3.\ldots\;\;n}$.

It is not necessary that n should be an integer. If it is not, of course both of the above series will consist of an infinite number of terms. This will not alter the final result. Had the examiner intended you to take n as an integer he would, we think, have written the answer $\frac{(-1)^n\lfloor 2n}{\{\lfloor n\}^2}$.

You will notice that the answer as you have given it requires a slight alteration.

30. R. C. BEAN, Crosby.—*For London 1st B.A.* (we give only authors' or publishers' names):—*History of England*, 1660-1714.—Green's Short History (Longmans'); The Fall of the Stuarts, Longmans' Historical Series. If possible read Macaulay's History for a general idea of policy and the course of public events. *History of English Literature during the same period.*—Professor Morley's book. *Dryden*, *Shakespeare* (*As you like it*).—Clarendon Press Series. These last are all annotated fully enough for your purpose. Of course your reading must be very much more extensive if for honours. Consult your bookseller as to prices.

31. M. A. SMITH, Chepstow.—A woman has a certain number of eggs, she sells ·3 of the number, and one more to one person; ·3 of the remainder to a second person; ·5 of the remainder to a third person; and after these sales has 15 eggs left. How many had she at first? (Pupil Teachers' Examination, Nov. 1880).

·5 of the second remainder were sold.
∴ ·5 ,, ,, ,, left.
∴ ·5 of the second remainder = 15.
∴ the second remainder = 30.

Similarly $\frac{2}{3}$ ($=1-\frac{1}{3}$) of the first remainder = the second remainder = 30. ∴ first remainder = 45. This and one additional, *i.e.*, 46, is $\frac{2}{3}$ of her original stock. Hence she originally had $\frac{3}{2}$ of 46, *i.e.*, 69.

32. X. Y. Z.—By selling out £4500 in the India 5 per cent. stock at $112\frac{1}{2}$ and investing the proceeds in Egyptian 7 per cent. stock a person finds his income increased by £168 15s. What is the price of the latter?

For his former income—

£100 produces £5.
∴ £4500 ,, £225.
This is increased by £168 15s.
Hence his income now is £393 15s.
Now £100 stock is worth £$112\frac{1}{2}$.
∴ £4500 ,, £$\frac{225}{2}\times45$.
Hence £$\frac{(225)(45)}{2}$ produces £$393\frac{3}{4}$.

∴ £$\frac{\cancel{225}\times45\times2\times7}{\cancel{1575}\;\cancel{225}}$,, £7.
∴ £90 ,, £7.
∴ The stock is at 90.

33. G. K.—Find the true discount on the following bill, £419 12s. 1d., drawn on March 6th, at 7 months, discounted September 15th at 5 per cent.

Bill would fall due on October 6th.
From September 15th to October 6th is 15+6=21 days.
In addition we have 3 days' 'grace.'
Interest on £100 for 21 days, at 5% is £$\frac{24}{73}$.
Discount on £$100\frac{24}{73}$,, ,, ,, £$\frac{24}{73}$.
,, £1 ,, ,, ,, $\frac{24}{7324}$.
,, £$\frac{30641}{73}$,, ,, ,, $\frac{\cancel{24}}{\cancel{7324}}\times\frac{\cancel{30641}}{\cancel{73}}$ (4, 2, 11)

Hence the discount is £$\frac{11}{8}$,
or £1 7s. 6d.

(Perhaps in your answer you forgot the 'three days' grace.')

34. R. GIBBONS, Stockport.—You do not put your sum quite plainly—How can money invested in stocks accumulate at simple interest? As we understand you, the answer you quote is wrong.

[Through the kindness of several correspondents, we point out a slight clerical error in *Query No. 17*, June, PRACTICAL TEACHER: 220 yards in 6 seconds gives 75 miles per hour, not $82\frac{1}{2}$. Making this alteration, the time of collision comes to be 12 minutes past 1 o'clock.]

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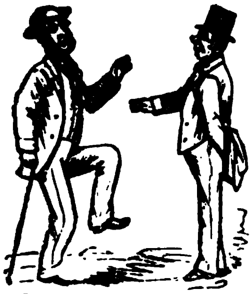
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Vice-President of the British Medical Association.

VI.—VENTILATION—*continued.*

IT being a part of the necessity of school life that children should be brought into close proximity with each other, and as close packing rapidly deteriorates the atmosphere in which they live, there is a natural tendency in their assembling together to poison each other. It follows that some means must be taken to obviate this tendency, and to prevent a serious evil. We have not far to look for those means, because it will always be found in nature that the allwise Author of our existence has placed the antidote not very far from the bane itself. The very circumstances which give rise to atmospheric deterioration at the same time set up conditions which provide a remedy if those conditions can have full play. There are natural laws which provide for the renewal of air in a given place if those natural laws are not impeded by some contrivance of man's invention. The first result of overcrowding is to raise the temperature of the room in which the crowd is assembled. The natural heat of the body is about 98·5; and when a number of persons are in close proximity to each other, even in the open air, their heat is imparted to the air in contact with their persons; and if they are in a closed room it is rapidly raised to a figure which, if other natural laws did not impede it, would raise the temperature of the room to 98·5, making it equal to that of the blood itself. But this tendency to equality is counteracted by the law which regulates the diffusion of gases and the tendency which exists between the air in the room and the air outside to equalize itself in consequence of that natural repulsion which exists between particles of a gas which are of the same nature. There are also other attributes of matter provided by nature to prevent the annihilation of the human species which would certainly result from the very attribute of things if some such provision was not made. One of the first results of a rise of temperature in a given room is the establishment of draughts. Whenever the air of a room has its temperature made higher than the outside air, by any cause whatever, there is an increase in the size of the molecules of the air itself which expels some of the warmed air from the room, the same condition is established by the air, as happens to water or iron under the influence of heat; each molecule expands and occupies more space than it did before. There is a tendency for the air in the room to diminish in material quantity by expansion in every direction. This causes a passage of air to take place from within outwards, and there is a commencement of the removal of the now adulterated air; but if air does get out, it follows, as a natural consequence, that air can also get in; and as the air outside is now colder than the air in the room, the cold air coming into contact with the warmer molecules causes them at once to contract their size and a vacuum is produced; more cold air gets in, and a draught is set up. This cold air has an increased impetus, and the colder it is the more certainly will it penetrate into the room with greater or less rapidity; the new intruders become warmed, and, expanding, press against those which resist their enlargement less decidedly, and which is in the direction of the warmer air; thus hot air goes out in one place and cold air enters by another, a more or less thorough draught is established. This is a part of the principle by means of which winds arise, and the air renewed on the surface of the earth. I stated that the problem was how to prevent the quantity of Co_2 in a given confined place from rising from the ordinary standard of ·4 parts in 1000 to some figure not much above that quantity. Nature gives us at once a means whereby this problem may be solved, viz.:—by admitting sufficient fresh air to keep the standard at its proper level; but this at once involves another problem which must be solved also if the principle of ventilation is to be a satisfactory one. A man upon an average inhales 16·6 cubic feet of air per hour, and produces about 12 to 16 cubic feet of carbon anhydride in 24 hours. To keep down the level of impurity to its allowed quantity involves the requirement of 100 times the volume of air for the purpose. It follows that more than 16·6 cubic feet per hour must be supplied for each individual for this object to be attained, and hence the tendency to excessive draught. How is this draught to be obviated? This is the second problem.

We must also bear in mind that there are many other sources of Co_2 in the atmosphere of a room than the human beings which it may contain. There is the great consumption of oxygen, and the rapid formation

of Co_2 in all cases in which lighting and heating are carried on. Combustion may cause even a greater deteriorate than that which is produced by human beings, although from causes presently to be mentioned, it is not always so dangerous in its results. Besides fires and lights, there are numerous kinds of animals, whose function it is to rapidly destroy the vital properties of oxygen; and there are also the thousand and one changes which are always going on in organic matter, by means of which still further quantities of oxygen are removed from the air, and to some extent returned as Co_2, in the oxidising changes which are always taking place around us. These sources of vitiation must be counteracted. There is therefore an absolute necessity for the introduction of great quantities of air to remove the carbon anhydride as rapidly as it is formed. Dr. Parkes calculates that 2,800 cubic feet of fresh air per hour are really regained for each individual, and under certain circumstances, such as sickness or during the time when a low state of health is present, this quantity ought to be much increased. Take a room, therefore, which contains fifty persons. It is necessary to make provision for the introduction of nearly 150,000 cubic feet of air per hour, to prevent contamination rising to too high a level. This introduction must also be equally diffused throughout the room, and not pass out again without conveying its proper quantity of Co_2 away with it. It will not do to imitate the action which is seen in the Lake of Geneva, where the muddy waters of the Rhone pass right through without defiling the waters of the lake. Let the picture be reversed, and let the river be pure water and the lake muddy, and you have no advantage from the current. Such is too often the result of the ventilation which is carried out now-a-days; although fortunately for humanity, there are qualities in air which do not so immediately belong to water. I mean the quality which resides in the law of diffusion of gases, and by means of which the molecules of a gas have a tendency to repel each other and to diffuse themselves into space whenever the opportunity allows them to do so. It is this law of diffusion which leads gases of different densities, and with different attributes, to rapidly diffuse themselves even in opposition to the law of gravity. Co_2 is a very heavy gas, and has a natural tendency to remain at the bottom of a room, because of its greater density as compared with common air; but that great preserving power which the law of diffusion provides leads to the rapid dispersion throughout the air of any quantities of Co_2 which may be discharged into space. Hence it happens that out of doors there is no great difference in the quantity of Co_2 at the top of a house as compared with the bottom, and the most thickly inhabited parts of a great city do not show out of doors any very serious diminution in the quantity of O, or of increase in the quantity of Co_2, a few parts in a million being the outside of this deterioration. The law of diffusion must therefore be a powerful means whereby the purity of the atmosphere is retained, provided the law has fair play. But it will be said, if it is necessary to admit 150,000 cubic feet per hour into a room which contains fifty persons, how can this be done without a draught being sent up? Here are the two problems —remove impurity and prevent draught. You have to take care that in the first place, the temperature outside shall not be capable of interfering very much with your arrangements. If the season is temperate provision must be made to so rapidly admit fresh air that there shall not be so great a difference between the inside of the room and the outside so as to set up currents in spite of the arrangements provided. If the temperature outside is cold, means must be provided for warming that cold air before it is admitted, and so prevent injury from that source. It will be seen from these observations, that a system of ventilation requires a series of entrances and exits which shall balance each other, and be capable of being regulated to meet the changes which arise from a rapid rise or fall of temperature, or from the increased or diminished number of human beings, or increased or decreased amount of chemical change which combustion or other oxidising causes may set up in a given room.

These observations will point out at once to the intelligent reader that there is no principle of ventilation which can be provided which, without adaption, will suit all conditions under which a school-house, or any other assembly for people may be placed. Those patents which are so often vaunted as perfect ventilators, and which are invariably without adjustment, are necessarily faulty; they may suit one set of conditions, but they cannot possibly do for another.

It is evident that if 150,000 cubic feet are required for fifty persons, it will not be necessary to admit that quantity into that room if there are only five; for this reason, the rapid introduction and removal of air tends to chill the persons exposed to that rapid removal by carrying away some of their natural heat as well as the impurity which they produce; hence an intelligent regulation is necessary to be observed, and it is required that in every school there should always be an individual who knows something of the requirements of ventilation, who shall be appointed to regulate the inlets and outlets, to consult the thermometer, both in the room and outside, and under certain circumstances also understand the theory of the dew point for reasons to be mentioned.

Respiration renders the expired air impure by the addition of other things besides Co_2: a variable quantity of organic matter is discharged from the lungs, and also by transpiration from the skin, which amounts in an adult to from 30 to 40 grains in the 24 hours; children give out much larger quantities, weight for weight, than adults do. This organic matter consists of particles of skin, fatty particles, and if there are diseased people in the room, particles of pus or matter, germs of fungi and other microphytes, and some volatile material, which is early discovered by the fetid smell which it produces in any room which is closely packed and imperfectly ventilated. The air of a dormitory just before sunrise, in which there are too many children and too little fresh air admitted, is sometimes very overpowering, as doctors too often find out, when, in cases of sudden illnes they have to pass from the pure air out of doors into the impure air of the bedroom. This organic matter when collected, by passing the air of such a room through water, which liquid easily retains it, very soon goes into putrefactive fermentation and gives rise to an excessively offensive product. Besides this organic matter, there is also a considerable quantity of aqueous vapour. If we take a glass of cold water suddenly into a crowded room, the outside of the glass will be immediately covered by a deposit of dew-like particles, and on a cold night the windows of a room which is crowded will be observed to be running down with water which has been condensed from the air inside

the room by simple contact with the cold glass. This condensed vapour collects on walls, ceilings, glass, furniture, etc., making them feel damp and clammy, and setting up that peculiar and offensive odour which is the attribute of all ill-ventilated and over-crowded dwellings. To live in an atmosphere or this kind is to condemn those who have to do it to a low state of health, to produce a strong tendency to the production of certain diseases. It enables the germs of infectious diseases to spread with great rapidity, and, even more serious still, it gives rise to the possibility of tubercular diathesis being set up in a whole district. If there happens to be in such a place a person who is suffering from disintegrating tubercle, that which is called rapid consumption, or persons having discharges of a so-called scrofulous kind, the breath disperses particles of organic molecular matter throughout the room. If it is inhaled by another, that other himself in a condition which allows the impure particle to find a nidus upon which it can increase and multiply, there is set up in that person a focus from which it too often happens that so-called consumption is established, and permanent ill-health produced. I firmly believe that persons in good health, and who are accustomed to live in pure air, are not likely to become consumptive from this cause, and they may feel certain that to them consumption is not infective. Before particles of infective tubercular matter can take root in a given body and grow, it is necessary for that body to be the possessor of debased material which has not been properly excreted. If that debased material is not present, the germs of infectious matter which has been accidentally inhaled are perfectly harmless—they can no more germinate than the grains of barley which are sometimes found in the tombs of the Egyptian kings. Air, moisture, etc., are necessary for the germination of seeds; so impure and rapidly changing organic matter, such as that which is washed out of the air of a close room and which has not been removed or oxidised, is the material in which the germs of infective tubercular matter can, and do, grow to the detriment of a whole district when a schoolmaster is afraid of fresh air, and keeps his pupils in an impure atmosphere.

The size of the room is not so important an element in the case as is the capacity for the entrance of pure air; and although the size of the room has an important bearing, and its cubical contents may be taken into consideration, it is not so important as the entrances and exits provided for the admission and discharge of air, and the floor space allowed to each child. The cubical contents may be much modified by the height of the walls: a room a yard square and fifty feet high would be no better for a child to live in than one a yard square and ten feet high. That illustration will serve to show the uncertainty which may belong to a consideration of numbers which are based upon the cubical contents of a given room.

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Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,
Joint Author of 'The Field Naturalist's Handbook.'

No. V.—THE COLEOPTERA, OR BEETLES.

PART II.

THE *Brachelytra*, or *Staphylinidæ*, popularly known as the Cocktail, or Rove Beetles, form the next of the principal divisions of the Coleoptera.

Their chief distinguishing characteristic is found in the elytra, which are wonderfully small, seldom covering more than two segments of the abdomen, the remainder of which is left free. In some cases, even, the elytra are shorter than the thorax.

In spite of the small size of the elytra, however, the wings are very large, and are folded and packed away beneath their cases in the most wonderful manner. This operation is chiefly performed by the tip of the abdomen, which is bent over the back for that purpose; hence, the name of Cocktails.

Most of the *Brachelytra* are long, narrow insects—some, in fact, being almost thread-like. They may be found in all sorts of decaying animal and vegetable matter, carrion, manure-heaps, cattle-droppings, etc., always containing them in great numbers. To the labours of these beetles, and some others, in fact, we are indebted for the prevention of numberless fevers and agues, for no sooner does garbage of any kind show signs of decomposition than it is attacked by the insects, and before long completely devoured.

In size, these insects vary very greatly. The well-known Devil's Coach-Horse (*Ocypus olens*), for example, attains the length of an inch and a quarter, while some of the smaller British species are of microscopical dimensions, never exceeding one forty-eighth of an inch in length.

This Coach-horse beetle is common enough almost everywhere, hiding under stones, rubbish-heaps, etc., by day, and sallying forth at night in search of prey. Its dull black colour, and threatening aspect, give it a most repulsive appearance, and few except entomologists would care to meddle with so unpleasant-looking an insect.

In reality, it can do very little harm, although its jaws are able to inflict a rather powerful nip. It possesses, however, the power of exuding a fluid of the most unpleasant and penetrating odour, which hangs about the fingers for days, and cannot be removed without considerable trouble. Most of the rove beetles make use of this unpleasant mode of defence, the fluid being secreted in two glands at the extreme tip of the abdomen.

The *Ocypus* is remarkable for the size of its eggs, which are of wonderful size in comparison with the dimensions of the insect, being no less than one-tenth of an inch in length. The larvæ are not unlike the parent insect, with the exception of the absence of wings.

A closely allied species, *Leistotrophus nebulosus*, is perhaps one of the most fierce and courageous of the group. Although considerably less in size than the *Ocypus*, it can do infinitely more damage, and if carelessly held will cause its jaws to meet in the flesh of the captor. This insect is rather a handsome one, being brown, mottled with grey and black.

Some of the smaller *Staphylinidæ* are only too well known as possessing a remarkable talent of flying into the eye, where they cause considerable irritation before they can be ejected. The little black 'flies,' which are so troublesome on summer evenings, are almost always *Brachelytra*, as can be seen by waving a sheet of gummed paper in the air, when the beetles will adhere to it.

NEXT in order we have the *Clavicornes*. These, as before mentioned, may be known by the structure of the antennæ, which are expanded at the tips into a kind of club.

The beetles of this group are far more variable in

size and form than are the *Brachelytra*. Some of them strongly resemble the insects of the latter group, the elytra being very short, and leaving the greater part of the abdomen unprotected. Many of these insects, all small species, are found in the nests of various ants, in company with some of the *Staphylinidæ*, where they are as jealously protected by the insects as are their own larvæ and pupæ, being carefully tended, and carried away into the interior of the nest at the slightest sign of danger. The object of their presence is not yet known.

Perhaps the most interesting beetles of this group are those popularly known as Burying, or Carrion Beetles, and scientifically as *Necrophori*.

Several species of these beetles inhabit this country, and are tolerably common, although seldom seen except by those who know how to look for them.

As their popular title infers, these beetles are chiefly to be found in carrion, and may be obtained in plenty from the carcase of any dead animal which is found lying in the fields. But their habits are very different from those of the *Staphylinidæ* and other beetles which are found in their company.

As soon as they detect the odour of decaying flesh, the burying beetles wing their way to the spot, not so much for the purpose of finding food for themselves as for providing it for their future offspring.

Now, if the eggs were deposited in the carcase as it lay upon the ground, decomposition would be complete in a few days, and the newly-hatched grubs would thus be left without food. In order to obviate this, the carcase is completely buried by the beetles, which shovel away the earth from beneath it by means of their broad and powerful heads. After digging for some little time, throwing out the earth as they proceed, they emerge from beneath the body, and rest for an hour or so. What follows can best be told in the words of the late Mr. E. Newman, in his famous 'Letters of Rusticus.'

'The male beetle then dives again into the grave, and pulls the bird down by the feathers for half an hour. Its own weight appears to sink it but very little. The earth then begins heaving and rising all round, as though under the influence of a little earthquake; the feathers of the bird are again pulled, and again the bird descends. At last, after two or three hours more labour, the beetle comes up, again gets on the bird, and again takes its survey, and then drops down as though dead, or fallen suddenly fast asleep. When sufficiently rested, he rouses himself, treads the bird firmly into its grave, pulls it by the feathers this way and that way, and having settled it to his mind, begins to shovel in the earth. This is done in a very short time, by means of his broad head. He goes behind the rampart of earth, and pushes it into the grave with amazing strength and dexterity, the head being bent directly downwards at first, and then the nose elevated with a kind of jerk, which sends the earth forwards. After the grave is thus filled up, the earth is trodden in, and undergoes a keen scrutiny, all the bird being completely hidden; the beetle then makes a hole in the still loose earth, and having buried the bird and his own bride, next buries himself. The female lays her eggs in the carcase of the bird, in number proportioned to its size; and after this operation is over, and the pair have eaten as much of the savoury viand as they please, they make their way out, and fly away in quest of further adventures.'

It will thus be seen that the carcase, being buried in the ground, is preserved in the best condition for the food of the future larvæ, for the moisture of the earth prevents it from drying up, while it is protected from the sun and rain which would cause it to decompose with undue rapidity.

Burying Beetles and dead Mouse.

The burying beetles are handsome insects, the ground colour being black, with two broad bands of orange crossing the elytra; one very common species, however, is altogether black. In the accompanying illustration some of these beetles will be seen engaged in interring a dead mouse.

The burying beetles are usually assisted in their task by some of the various Histers and *Silphidæ*, of both of which there are many species. The former are rather small, highly-polished insects, which feign death on being touched, rolling up the legs beneath the body, and remaining perfectly still until they imagine the danger to be past. They are chiefly black in colour, although some of the species are spotted with red. The Silphas are flat beetles, with the head almost entirely hidden away beneath the thorax. These latter insects are also common in old bones, and also in the carcases of 'vermin' suspended on the 'keepers' trees' in coverts.

To the *Clavicornes* also belong the *Trichopterygidæ*—beetles so small that a powerful microscope is necessary in order to distinguish them from one another. These tiny insects are common in rubbish heaps, looking like living black specks as they move about.

Another interesting family in this group is that of the *Dermestidæ*, the commonest species of which, *Dermestes lardarius*, is popularly known as the Bacon Beetle.

These insects, like the burying beetles, are carrion feeders, and are abundant in the carcases hung upon the 'keepers' trees' before-mentioned, preferring, however, the dried skins to the decaying flesh. In museums they are terribly destructive, detecting any skin which has not been properly prepared, and reducing it to fragments in a very short space of time.

The Pill Beetles *(Byrrhidæ)* also belong to this group. The beetles of this family possess a wonderful faculty of simulating death when alarmed, the legs and antennæ fitting closely into grooves upon the under surface of the body, and the creature resembling a small dusty stone far more than an insect.

While thus feigning death, the pill beetles will allow themselves to be picked up and handled without

evincing the slightest sign that they are living objects, and not until the danger may be supposed to have finally disappeared do they unroll their limbs and continue their journey.

Some of the Clavicornes are inhabitants of the water although in a different way to either the true water-beetles, or the *Hydrophilidæ*. They do not swim actively through the water in pursuit of prey like the former, or spend their existence in crawling upon the aquatic weeds, etc., as do the latter, but are chiefly found clinging to the under surfaces of stones lying in the beds of swiftly running streams.

NEXT we come to the Lamellicorns, or 'leaf-horned' beetles. These derive their title from the structure of the antennæ, the club of which is composed of three or more plates attached to each other at one end, and usually movable like the rays of a fan. These beetles are popularly known as Chafers.

The most abundant and best known of these is the common Cockchafer *(Melolontha vulgaris)*, which is so terribly destructive to the farmer and agriculturist.

Cockchafer.

The egg ot this insect is laid beneath the ground, and the grub, which shortly emerges, feeds upon the roots of the grass and other crops, often doing incalculable damage. In some places, even, the turf may be rolled up by the hands, the roots of the grass having been completely destroyed by the grubs.

Larva of Cockchafer.

The perfect insect is fully as destructive, feeding upon the foliage of trees, and sometimes entirely stripping them of their leaves. The larva and pupa as well as the perfect insect, are shown in the accompanying illustrations.

Pupa of Cockchafer.

The well-known Dor, or Watchman Beetles *(Geotrupes)*, are also included in this group. These form the direct opposite of the preceding beetle, being absolutely beneficial to mankind by removing the dung of animals beneath the ground in somewhat the same manner as carrion is buried by the *Necrophori*.

The dor beetle, when about to deposit her eggs, selects a patch of cow-dung, and burrowing her way into it, digs a tunnel some ten or twelve inches in depth into the earth beneath; by means of her powerful front legs and head. Ascending again to the surface, she carries down a portion of the dung to the bottom of her tunnel, deposits an egg in the midst, and sets to work at a second tunnel, and so on until she has laid the whole of her eggs. The grubs, when hatched, feed upon the food thus stored up for them until they are able to ascend to the surface of the ground and cater for themselves.

Some of these dung-loving beetles are constructed in a manner which strongly reminds one of the curious forms found in the tropics. Especially is this the case with the insect scientifically known as *Typhæus vulgaris*, but possessing no popular name. In this species the thorax is developed into three horns, or teeth, two of which project on either side, enclosing the head between them, while the third slants obliquely upwards midway between them. The male, only, possesses these singular appendages, which, in the female, are merely represented by small pointed knobs.

The strength of all these burrowing insects is very great, that of the fore-limbs, upon which falls all the burden of the work, being especially remarkable. This can be easily proved by attempting to confine one of these insects in the closed hand, when the strength of the digging legs will be found as much disproportioned to the size of their owner, as that of Hercules would be in the arms of an ordinary human being.

Yet, when we consider the work done by these insects, we marvel, not at the power of their limbs, but at the fact that creatures so tiny, strong though they may be, should be able to perform such feats. For an ordinary dor-beetle to burrow some twelve inches into the ground is much the same as if a man of ordinary stature were to dig, aided by no other tools than those with which nature has provided him, a tunnel of seventy-two feet in depth, and exceeding in diameter the size of his body.

These beetles are most abundant in the spring and autumn, when they may be seen circling about at dusk, searching for a favourable spot in which to deposit the eggs.

The well-known Stag Beetle *(Lucanus cervus)* is also a member of this group. This is a very unequally

distributed insect, in many places being exceedingly common, while in others it is never seen.

There is a considerable difference between the sexes, the male being a much larger insect than his mate, and possessing long and toothed jaws, those of the female being short and sickle-shaped. It is not the case, however, as might be thought, that the bite of the male is the more severe, for his jaws can do little or no damage, while the sharp mandibles of the female can inflict a tolerably severe bite, sometimes even meeting in the flesh.

The jaws of the stag beetle, and more particularly of the female, are capable of considerable exertions. I remember a case in which a female specimen of this insect, one of my own capture, was placed inside a strong willow-chip box and forgotten. Some days afterwards, upon looking at the box, the beetle was found to have worked her way partly through the side, having gnawed a hole large enough for her head and her fore-legs to pass through. When once in this position, however, she was unable to move either backwards or forwards, and, had she not been released, must have remained fixed until death set her free.

The stag beetle is one of the wood-feeding insects, the larva dwelling in the trunks of trees. Remaining, as it does, in this state for several years, during the whole of which time it is burrowing in the wood, it can be easily imagined that it causes no little havoc, and if a tree is attacked by several of these larvæ its doom is sealed.

When full-fed, the larva leaves the wood and burrows into the earth, where it constructs for itself a strong cocoon in which to undergo its change to the pupal condition. The perfect insect appears in reality about the middle of winter, although it is seldom seen at large until June; for pupæ, opened in January, have been found to contain fully-developed insects. This is also the case with many other beetles, which, undergoing their final change during the winter, do not make their appearance in the world until considerably later in the year.

The size of the stag beetle is exceedingly variable, a well-developed male sometimes attaining the length of three inches, while other specimens are barely one-half of that size.

(*To be continued.*)

Anecdotal Natural History.

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No. VII.—THE CAT TRIBE.

PART III.—THE JAGUAR, PUMA, ETC.

THE Ounce (*Leopardus uncia*) of Asia resembles the Leopard so closely, both in appearance and habits, that a detailed description is unnecessary. It may be distinguished from either of the preceding animals by the woolly aspect of its fur.

We therefore pass it by and come to the Jaguar (*Leopardus onca*) of the American continent. In its native country the animal is usually spoken of as the Tiger, just as the bison is erroneously dubbed the buffalo.

The jaguar is by no means unlike the leopard in form and markings, but may be easily distinguished by one or two peculiarities.

In the first place, two or three bold black stripes are drawn longitudinally across the breast, these being never found in the leopard. The spots, too, with which the body is thickly covered, are more angular in shape than is the case in that animal, and are formed like rosettes, each containing either one or two smaller spots in its centre. Along the spine, from the neck to the first foot or so of the tail, runs a chain of solid black spots and dashes. The tail, too, is much shorter in proportion to the size of the animal, and barely touches the ground when its owner is standing erect.

The ground colour of the jaguar's fur is a bright tawny brown, in some specimens being much more brilliant than in others. A black variety is occasionally met with, just as is the case in the leopard, the whole fur assuming the dusky hue of the spots, which are very indistinct, and only to be distinguished in certain lights.

Like the tiger, the jaguar is of an extremely cautious nature, and seldom ventures upon an open attack, unless his enemy be very much inferior in size and strength to himself. Should he meet with a herd of animals, or a party of travellers, he will dog their steps for miles, hoping to surprise an individual when separated by a short distance from his comrades.

As regards his food, the jaguar is extremely impartial, and preys alike upon all branches of the animal kingdom. His favourite diet is, perhaps, the flesh of the various monkeys which inhabit the American forests, the attainment of which delicacy, however, is attended with considerable difficulty.

For, though the jaguar is an adept in the art of tree-climbing, and can make his way among the branches with considerable ease and facility, the monkeys are even greater proficients, and, by the quickness and agility of their movements, would soon distance their pursuer if he resorted to open chase. His usual method of obtaining his favourite food, therefore, is by leaping upon the unsuspecting animals from some place of concealment, or by surprising them when asleep. In such a case a few strokes of his powerful paw dash several of the animals to the ground, where their assailant can devour them at his leisure.

Another favourite delicacy is the flesh of the peccary, the procuring of which is fraught with equal difficulty and far more danger than is the case with the monkeys.

For the peccary is distinguished by the possession of a fierce, unreasoning courage, causing it to dash at the most formidable foe, and wreak its vengeance with its terrible tusks, which cut like so many razors. In fact, if a jaguar were to be attacked by a herd of these little animals, he would have no chance against them, and could only save his life by resorting to a tree until their patience became exhausted, and they retired from the neighbourhood.

The capybara falls a frequent victim to the attacks of the jaguar, who even follows it into the water. Large animals, such as horses or deer, it kills in the same manner as does the leopard, namely, by leaping upon them from the overhanging branches of some tree, and breaking their necks by a powerful wrench with the fore-paws. Even animals of considerable size are carried off without difficulty by the jaguar, which has even been known to attack two horses which were tethered together, kill one, and drag both animals to its lair, in spite of the struggles of the survivor.

Of birds, also, the jaguar is fond, and strikes them down with a blow of his paw. Even should his intended prey take to flight, he is often able, by one of his wonderful bounds, to capture it before it has passed beyond his reach. Fish he captures by lying in wait upon the banks of a stream, and hooking them out with his paw as they pass beneath him. Turtles, too, often fall a prey to him, and are killed and eaten in a very ingenious manner.

Watching for the female turtles as they make for the sea after laying their eggs in the sand, the jaguar springs upon them, and quickly turns them upon their backs, a position in which they are perfectly helpless. He then breaks away the softer parts of the shell by the tail, and, inserting his paw, scoops out the whole of the flesh through the aperture thus made. Of the eggs, too, hė is very fond, digging them up from the sand in which they were deposited. Lizards, shellfish, and even insects also fall victims to his voracious appetite.

In farmyards the jaguar is a terrible enemy, doing the utmost damage among stock of all kinds. Some of the earlier settlers, in fact, were so troubled by these animals that they found it perfectly impossible to keep any live-stock whatever until the jaguars were finally driven from the neighbourhood. And this was no easy task, the craft and cunning of the animals rendering it a very difficult matter to kill or trap them.

The hunting-dogs of the country show a wonderful aptitude for tracking the jaguar, as is well described by the late Mr. C. B. Brown, in his *Camp and Canoe Life in British Guiana*, as follows:—

'Many of the Indian hunting-dogs, trained for deer or tapir, will hunt tigers (*i.e.*, jaguars). When on the track of either of those animals, should they come across the scent of a tiger, their eager and confident manner of pressing on after the game is immediately changed, and, with the hair on their backs erect, they become cautious and nervous to a degree, jumping at even the snapping of a twig. Abandoning the hunt, they take up the tiger's track, and follow it. But should the huntsman call them from it, or not cheer them on with his voice from time to time, they exhibit great fear, and, keeping close to his heels, cannot be induced to hunt any more in that district for that day.

'On the contrary, if allowed to follow the tiger, they track it up with caution, being fully aware of the cunning dodge practised by that animal; which is, when the dog is close at hand, to spring to one side and lie in ambush until it passes, when with one spring the dog is seized.

'Ordinary dogs would fall a prey to this trap, but not the self-taught tiger-dogs. Their fine powers of scent warn them of their near approach to the quarry, when they advance with great caution, never failing to detect the tiger in time, and when once their eye is upon their enemy it has no chance of escape.

'In its pride of strength the jaguar scorns the dogs, and, with a rush like a ball from a cannon, springs at one of them, feeling sure that it cannot escape.

'It has reckoned, however, without its host, for the dog eludes the spring with ease, and with great quickness flies on the tiger's flank, giving it a severe nip. As the tiger turns with a growl of pain and disappointment, the dog is off to a little distance, yelping lustily, and never remaining still an instant, but darting first on one side and then on the other. After one or two ineffectual charges the tiger gives it up, and on the approach of the hunter springs into the nearest suitable tree, which it seldom leaves alive.'

The jaguar is very tenacious of life, and even when mortally wounded will often travel to a considerable distance before it succumbs to its hurt.

This animal seems more easily tamed than most of the larger members of the Cat tribe, and becomes thoroughly domesticated, following its master like a dog, and allowing all manner of liberties to be taken with it without resenting them.

The Puma *(Leopardus concolor)* is the next of importance among the members of the Cat tribe. This animal is known under a bewildering variety of names, among which may be mentioned the American Lion, the Panther (or 'Painter'), Cougar, and the Gouazouara. Sometimes, too, it is erroneously termed the Carcajou, which is one of the deer tribe, and the Kinkajou, a remarkable animal belonging to the ursine group.

The title of American Lion evidently refers to the colour of its fur, which is of an uniform tawny hue like that of the animal after which it is named. The tip of the tail is black also, but does not possess the tuft of hair which is a distinguishing characteristic of the true lion.

The puma is by no means so large an animal as any of the preceding, seldom exceeding six feet and a half in total length, of which almost one-third is occupied by the tail. The head is remarkably small, causing the animal to appear even less in size than is actually the case.

It is a rather curious fact that the cubs of the puma should be marked during their infancy with greyish-black stripes, just as are the young of the lion. Besides these, a number of darker spots are visible over the greater part of the body, both stripes and spots disappearing in the course of a few months.

The puma is another of the tree-climbing cats, and its limbs are wonderfully strong and powerful in order to fit it for its semi-arboreal life. Its habits, when in search of prey, strongly remind one of those of the jaguar, crouching, as it does, like that animal, among the branches of some convenient tree until an animal is unfortunate enough to pass beneath. While resting among the foliage it is remarkably inconspicuous, the body being flattened against a bough, and the dark-tawny fur harmonizing almost perfectly with the bark.

Although terribly destructive in farmyards and so on, as many as fifty sheep in one district alone having been known to fall victims to the animal in the course of a single night, the puma is not personally feared by the settlers and hunters. When meditating an attack it is even more cautious than the jaguar, often following its quarry for miles without daring to show itself. Even when it summons sufficient courage to follow up its attack, and arrives within springing distance of its intended victim, it cowers and shrinks away if a bold front be shown, appearing unable to withstand the gaze of the human eye.

The food of the puma is much the same as that of the jaguar, the peccary and the capybara being especial favourites with it.

The various species of Felidæ, called TIGER-CATS, include several pretty and graceful animals, such as the Ocelots, the Margay, the Rimau-Dahan, and the Chati.

The Ocelots are all inhabitants of tropical America, the most abundant species being that known as the Common Ocelot *(Leopardus pardalis)*. This animal is a singularly pretty one, some four feet in length, from the nose to the tip of the tail, and standing about eighteen inches in height at the shoulder. The ground colour is a delicate greyish fawn, marked with broken bands of darker fawn edged with black. Along the spine runs an unbroken black line. The ears are black, with the exception of a white spot upon the back.

In consequence of the handsome markings and delicate fur, the skins of these animals are much sought after.

Another species is the Grey Ocelot *(Leopardus griseus)*, which is of a lighter colour than the preceding animal, the spots, also, being less numerous and distinct. All the species are very quick and active in their movements, and in form and habits strongly resemble miniature leopards.

OUR own domestic cat, really a descendant from the Egyptian animal *(Felis maniculata)*, is generally supposed to have sprung from the Wild Cat *(Felis catus)*, which at one time was very abundant in this country. In the olden times, when hunting and warfare were almost the sole occupation of the upper classes, this animal was even preserved for the chase, just as is the fox at the present time, and severe penalties were enacted against those who should cause its destruction, except in the legitimate manner.

At the present day, the Wild Cat is almost extinct, as far as regards Great Britain, a few scattered specimens, only, existing in some of the Scottish mountain woods. There it causes considerable havoc amongst the game, just as our domestic cat will if it once imbibes a taste for poaching. In fact, there is hardly a more inveterate enemy to partridges and pheasants than a pet cat, which will visit the coverts night after night, and destroy the birds in numbers, often paying the penalty with her own life should the keeper happen to meet with her. Many tame cats, even, leave their homes, and take entirely to a wild life, living on the game which they capture. When trapped, these are often mistaken by the keepers for the genuine wild species. It is hardly possible to pass through a preserve without noticing the dead bodies of several cats, which have been shot by the gamekeepers, and hung up on the 'keepers' trees' in company with the carcases of weasels, stoats, etc., as a warning to other 'vermin.'

The differences between the wild and the domestic cats are very apparent. The markings of the former vary but very little, the ground colour being an uniform yellowish grey, while a number of dark streaks run round the body at right angles to the line of the body and limbs, reminding one rather strongly of the markings of the tiger. A chain of black spots runs down the spine as far as the tail, which is very much shorter and more bushy in proportion than that of the domestic species. The tip, for an inch or so, is invariably black, the rest being banded in the same way as the body. The ears, too, are much shorter than those of the tame animal, and the aspect of the creature is remarkably fierce and savage. Its character is not belied by its appearance, for its courage and ferocity are so great that even to an armed man it is no contemptible foe.

The Lynxes form a very conspicuous group. The Common Lynx *(Lyncus virgatus)* of Southern Europe is well known by name, its keenness of sight having passed into a proverb. It is spread over a considerable part of the mountainous parts of South Europe, and is also found in many of the forests of Northern Asia.

The Lynx is not a very large animal, being about three feet in total length, exclusive of the tail. The fur is of a dark-grey colour, varying slightly, according to the season of the year, with darker spots of various sizes. The tail is very short, sometimes being barely six inches in length. The ears are remarkable for the tuft of long hair which fringes the tips.

The Canadian Lynx, or Peeshoo *(Lyncus Canadensis)* is chiefly noticeable for its mode of running, which operation consists of a series of bounds, all four feet coming to the ground almost simultaneously. The fur, which is long and fine, is much sought after.

There is another species, the Booted Lynx *(Lyncus caligatus)* found both in Asia and Africa, which is so called from the deep black colour of the lower parts of the legs, causing them to appear as though enclosed in tightly-fitting boots. None of the Lynxes are particularly destructive, except to the small animals, such as hares, rabbits, etc., upon which they prey.

One of the most interesting of the Cat tribe, and the last which can be mentioned in this paper, is the well-known Chetah, or Hunting Leopard *(Gueparda jubata)*, sometimes termed the Youze.

The Chetah is found both in Asia and Africa, but in the former continent alone has been brought under the dominion of man. In size it is slightly superior to the leopard, its long limbs causing it to appear even larger than it is in reality. The markings are not unlike those of the leopard, to which animal, however, it is by no means closely related, appearing to form a connecting link between the feline and canine races. It is only slightly possessed of the power of climbing trees, and its limbs do not possess the strength of most of the cats.

Unlike most of its tribe, the Chetah captures its prey by open chase, and it is in this way that it is made useful to man, the animal being carefully trained for capturing game by many of the Asiatic races.

For this purpose, the animal is blindfolded, and taken out to the scene of operations in a light cart, where he is kept until a herd of deer or other game comes within sight. The hood is then removed, and the animal's attention directed towards the quarry. The Chetah immediately slips gently off the car, always doing so on the side which is away from the deer. Flattening his body on the ground, he creeps up to within a short distance of the unsuspecting animal, taking advantage of any bush or stone as a cover. He then launches himself upon the doomed animal, seldom needing more than two or three springs, fastens on its neck, and pulls it to the ground. The keepers immediately hurry to the spot, and take off his attention by offering some dainty, such as a ladleful of the blood. The slaughtered animal is then secured, and the Chetah is hooded and led back to the car, when he waits for another victim.

The Chetah is very easily tamed, being naturally of a very gentle and placid disposition. Even a newly-caught individual is easily managed, seldom or never exhibiting the savage nature of the lions and tigers, and other members of the Cat tribe.

(To be continued.)

Short Historical Anecdotes.

BY REV. SIR GEORGE W. COX, BART., M.A.

(30) Two Sieges of Constantinople, 1204; 1453.

Early in the thirteenth century Constantinople fell into the hands of the Crusaders, and the throne of the Eastern emperors was filled by a Latin sovereign, who hoped that he might bequeath it to a long line of successors. With those who supported him, he also hoped that the long schism which had rent Christendom asunder had been brought to an end by the triumph of the armies of the Cross. But the triumph was celebrated after a fashion which boded ill for the permanence of the new dynasty, or for the reconciliation and harmony of the Eastern and Western Churches. Crowds half mad with excitement and rage pressed into the church of Sancta Sophia, the mighty work of Justinian. A shameless woman, with disgusting gestures, screamed out a profane song from the chair of the patriarchs, while those who could fight their way to the altar drained off the wine in the vessels placed upon it. Mules and horses, driven into the churches to carry away the sacred treasures, were lashed if they fell, till their blood streamed on the pavement; while plunderers, who had a more careful eye to the future, were busy in stripping the reliquaries of the bones of saints to be carried to the great cities and churches of Western Europe.

Two centuries and a half later, Constantinople was again besieged, and again taken. After an obstinate defence of fifty-three days, the last Palæologus fell fighting bravely for his crown and his people. His only fear was that he might fall alive into the hands of the infidels, and he was heard to ask, 'Cannot a Christian be found to cut off my head?' None were ready to do him this service, and casting off the purple, he was presently buried beneath a mass of dead. The streets of the city again streamed with blood, and the populace poured once more into the great church of the Holy Wisdom (or St. Sophia). Every part of the vast building was filled with fugitives, who felt sure that there they would be safe, for they were assured by a prophecy which told them that the Turks would be smitten back when they reached the column of Constantine in the square before the church, and that the instrument of their discomfiture would be a sword brought down from heaven by an angel, who would place it in the hands of a poor man seated at the foot of the column. The hope was not to be realised, and the discords of centuries were now to be punished by worse than death for thousands who were saved for a life of shame. The Turks broke down the doors by the strokes of their axes: the crowds within the building were soon made prisoners and sorted for the market. Not less, probably, than sixty thousand were sold into slavery. The dome of Justinian, of which the people had delighted to speak as the second firmament and the throne of the glory of God, was stripped of its gold and silver, and a scene of riot was repeated, more hideous even than the orgies which followed the victory of the Crusaders under Baldwin and Dandolo. But in great and overwhelming calamities the popular mind can still take refuge in hope; and the temper which led Englishmen to believe that Harold had not fallen at Hastings, comforted the Greeks of Constantinople with the assurance that in four centuries the city and empire would be freed from the Turkish marauders, and the sanctuary cleansed from its pollutions. Hidden within its mighty walls the priest (so the legend runs) stands ready vested, to come forth when the hour arrives, and offer up the great Christian sacrifice once more upon its altar.

(31) The Funeral of Charles V. at Yuste, 1558.

Those who have read Washington Irving's delightful story of the *Rose of the Alhambra*, may fancy that the ceremony which the Emperor Charles V. went through shortly before his death was simply a freak such as that which Irving ascribes to the weak and foolish Philip V. Philip's great predecessor on the Spanish throne was never more thoroughly in his senses than when he gave orders for the celebration of his own funeral rites while he yet lived. Such ideas are perhaps not likely to arise without some suggesting cause; and the biographer of Charles's cloister life at Yuste points out that the Bishop of Liege, who was his ambassador to the Diet at the time of his election to the imperial throne, had been in the habit of following his coffin year by year in solemn procession to the tomb which he had built for himself in his cathedral-church. During his sojourn at Yuste, Charles had been specially careful to celebrate the obsequies of his friends, as they were removed by death from this earthly scene; and masses for the soul of his father, mother, and wife accompanied the daily masses offered for himself. He now ordered dirges to be said for them, and having so done, asked his confessor whether it would not be well for him, by celebrating his own funeral rites, to do for himself at once what would in any case soon be done for him by others. To the confessor's answer that he might yet live for years, and that at the proper time all that was necessary would be done without his troubling himself about the matter, Charles replied by asking simply, 'Would it not be for the good of my soul?' and being told that it would, gave orders for the carrying out of the ceremonial on the following day. The high altar blazed with lights; round the catafalque before it the household of the emperor were seen clad in robes of deep mourning; and while the mass for the dead was being sung, the emperor came forward and gave up his taper into the hands of the celebrant priest in token of his readiness to surrender his soul into the hands of his Maker.

The rest of the day, after having dined, he spent in the open air of the court, and the heat of the sun as it beat on the white walls gave him a violent headache. But the next morning he was better, and said that the ceremony of the previous day had done him good. Later in the afternoon he was found to be suffering from fever, and was carried to his bed, which he never left during the three weeks which were yet to pass before his death.

(32) James the Second and the Duke of Monmouth, Uncle and Nephew.

The sudden changes from splendour to wretchedness, and from high hope to utter despair, which meet us in the history of every age, have seldom been more

vividly exhibited than in the career of the favourite son of Charles II. The better qualities of the ill-starred Duke of Monmouth will be familiar to all readers of Sir Walter Scott's tale of *Old Mortality;* and the picture, it may fairly be said, is in no way overdrawn. His weakness was shown when he allowed interested and selfish advisers to entangle him in a desperate enterprise, by claiming a throne to which nothing less than his election by the whole people could give him the smallest title. The story of his rebellion resembles the course of a day which, bright and glowing at the first, becomes soon clouded and stormy, and Monmouth had little of the power which can stand out against or retrieve disaster. His reception at Taunton, where a train of girls presented him with a flag embroidered with the signs of royal dignity, shows him as the champion of Protestantism. Accepting the Bible presented to him, Monmouth said that it was his mission to defend the truths contained in that book, and to seal them, if it must be so, with his blood. A few days later, after the fatal catastrophe at Sedgemoor, he was brought, with his hands tied behind his back, into the presence of the King, his uncle, whom in his declaration he had denounced as the poisoner of his brother and the murderer of other men. His bravery was now all gone, and his one prayer was for his life; but if Monmouth lowered himself by his entreaties, James the Second sank still lower by the cruelty which prompted him to see his nephew when he had made up his mind not to spare him. To his reasons for not sparing him it was impossible for Monmouth to make any reply. All that he could do was to try and shift the guilt upon others, by pleading his ignorance of the contents of the declaration to which he had subscribed his name. This, James coldly said, was past all belief, and Monmouth felt that his only chance was to hint at his readiness to adopt his uncle's faith. He spoke of submitting himself to the Church of Rome, and James eagerly offered the spiritual assistance of which he might stand in need. Monmouth waited a few moments for some more cheering promises of mercy, but none came. 'Is there, then, no hope?' he asked. James was silent; and Monmouth, seeing that the die was cast, rose up and moved firmly from his presence. Two days later the last scene of the terrible drama was enacted on Tower Hill. The axe fell on Monmouth's neck; but in many parts of the country men were slow to believe that the prince, whom their reverence had exalted into a hero, was gone, and for them Monmouth passed into the illustrious band which numbers in its ranks the English Arthur and Harold, Sebastian of Portugal, the Tells of Rütli, and the Moor Boabdil. All these had only vanished for awhile from the scene of their former greatness, but they were to return one day with more than their former strength, and take full vengeance on the enemies by whom they had been smitten down.

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'How I Teach Elementary Science.'

FOURTH SCHEDULE SUBJECTS: MECHANICS.

BY RICHARD BALCHIN.

WHATEVER may be the case with other branches of knowledge, with science it is quite certain that we can't get on at all unless we agree that certain words shall carry with them absolutely definite meanings. Everybody must have found how difficult it is to talk reasonably with some people, because one minute they will be using a word to which they attach one meaning, and the next minute they will be using the same word in quite a different sense. I remember once, at York, listening to a prolonged discussion between Mr. Cooper and Mr. Holyoake. The first night was a complete failure; and for this reason: when Mr. Cooper said 'nature' he meant one thing, but Mr. Holyoake, in using the same word, meant quite another thing. And Mr. Cooper himself, at the beginning of his remarks, employed the word to signify what we commonly understand by natural objects, such as rivers, mountains, trees, etc.; while at the end of his speech, in what the people called a peroration, he used the word to mean some 'beneficent intelligence' whose will has produced these objects. And so the want of attaching definite meanings to terms landed these two travellers after truth in a perfect quagmire of tomfoolery. In remarkable contrast to this looseness in the use of words, I may instance two exceedingly thoughtful lectures I heard a few sessions ago at the London Institution: one by Huxley, on the place of the 'Belemnite' among cephalopoda; and the other by Procter, on the 'Birth of Worlds.' There was one characteristic of these lectures that intensely charmed and delighted me: the extreme care in the use of words. 'Tissue' always meant 'tissue' and nothing else. 'Heat' always meant 'motion of atoms.' It was never used to signify the cause of heat, nor the effects of it, but the thing itself. 'Secretion' stood for one definite idea: it was never confused with 'concretion.' The result was, I came away with a fresh stock of accurate knowledge. But after some of our teachers have given their lesson, I often wonder in what way the boys are benefited by it. The teacher calls an 'apostrophe' an 'inverted comma' when it is *not* inverted, calls something a 'compound' when he means 'mixture,' says 'qualify' when he means 'modify,' speaks of 'atom' when it should be 'molecule,' confuses 'particle' with both 'atom' and 'molecule;' and as to the words 'force,' 'energy,' 'power,' 'work,' and 'momentum,' any one of these is applied to all manner of different things, and the hopeless jumble of ideas is quite painful to conceive. How such a chaotic confusion can produce any educative result is most hard to tell.

Having these things before me, I have always felt that the first stage in mechanics is very valuable in leading both teachers and boys to attach clearly defined meanings to words, especially to words used to signify the 'properties of matter.' To accurately distinguish, for instance, between 'elasticity' and 'flexibility;' not to confuse 'cohesion' with 'attraction;' to clearly define 'liquid' and 'fluid,' and so on. In explaining some of the properties of matter and its different states, one has frequently to use the terms 'particle,' 'molecule,' and 'atom;' hence I always devote one or two lessons to the meanings and use of these words. Afterwards I never make use of them, except to carry the precise values here given to them. I can scarcely overrate the importance of this. Some of our boys gain scholarships or in other ways continue their education after they leave our elementary schools. I wonder how much of what they have learned with us they have to *unlearn* when they 'go up higher'! They

ought not to have any. For although we profess to teach but the elements of science, still the elements should be accurate.

The following is an outline of a lesson on the terms 'particle,' 'molecule,' and 'atom.' The class consists of about fifty boys in Standards V. and VI. A piece of chalk, a magnet, a magnifying glass, and a microscope are on the table before the boys. The blackboard is up and empty. I begin the lesson.

Arthur Young, will you take this magnet and draw it gently about on the stone stairs, and when you find something sticking to it bring it in? Now, my boys, look at the sun's rays coming in at that window: can you see anything floating about in them? Ans.—Yes, sir; a lot of little bits of stuff. Yes; you can see a great number of small pieces of matter moving about. Do you think there are any such in other parts of the room? Ans.—No, sir. Ah! you are mistaken. If the sun were shining through any other window we should see them. The air is quite full of such small divisions of matter. In fact, I will explain to you in another lesson that we should not see the rays of light at all but for these little pieces. Come here, Smith. There, I have rubbed some of this chalk off on to your finger: now take the magnifying glass and tell me what you see on your finger. Ans.—A great many little pieces of chalk. Can you see with your naked eye that the chalk-mark consists of a number of little pieces? Ans.—No, sir; not very well. Now, I see, Young has brought in the magnet. Well, Arthur, what have you fished up? Anything? Ans.—Yes, sir: look! there is such a curious bunch of little bits of iron sticking on to the ends of the magnet. Indeed? Did you think you would find such things on the stairs? No, sir: I thought there was only dust. Just so; but then these little pieces of iron were part of the dust. (A boy)—Please, sir, where did they come from? (Another boy)—They came off our boots as we went up and down stairs. Yes; that is right. What other pieces, do you think, might be found among the stair-dust? Ans.—Pieces of leather, little bits of stone and wood. Yes; and the larger pieces keep to the ground, and the school-keeper sweeps them up. But what becomes of the very small, light pieces? Ans.—They blow about in the air. Yes; and those are what you can see in the sun's rays. But I will give you a word to mean little bit, or small division of matter. I will write it on the board. 'Particle.' Now what are we to understand by 'particle'? Ans.—Any very small piece of matter. Can you see a particle? Ans.—Yes, sir. (Another boy)—Please, sir, you can't see all particles: some are too small to be seen. Indeed? Tell me some particles that you can't see. Ans.—I could not see the particles of chalk on my finger until I used the glass. Well, what then? Ans.—Then I could see them. Just so: you *could* see them; but you said you couldn't. Ans.—I said I couldn't without the glass. Very well; still it *was* seeing them even when you used the glass; was it not? Ans.—Yes, sir.

Now, boys, what is this I hold in my hand? Ans.—A piece of chalk. You have had a few lessons on 'chalk.' Tell me what chalk is, chemically speaking. Ans.—Carbonate of lime. What is carbonate of lime? Ans.—Carbon dioxide and lime. What is the common name of carbon dioxide? Ans.—Carbonic acid. Bailey, come here and write on the board the symbol for carbonate of lime. Ans.—CaO, CO_2. Thank you: that is right. What does the Ca mean? Ans.—Calcium. And the O? Ans.—Oxygen. And the C? Ans.—Carbon. What does the O_2 stand for? Ans.—Two parts of oxygen. I will now rub some chalk on to this little piece of blue paper, and place it under the microscope. What do you think I can see? Ans.—Particles of chalk. Yes; and each particle looks like a large rough block. I can easily suppose each piece to be capable of being split up into fifty or sixty smaller pieces. Still, what would be the composition of one of these smaller pieces? Ans.—Carbonate of lime. Just so; and you would not be able to see it with the naked eye, but only with the most powerful microscope. Now we may conceive each one of these minute specks to be yet further divided, so that they could not be seen either by the naked eye nor by a microscope, yet each of these would still be carbonate of lime. I will write on the board a name for those smallest conceivable divisions. 'Molecule.' Now tell me the difference between a particle and a molecule. Ans.—A particle can be seen, although it is very small; but a molecule can only be imagined. You said just now that even a molecule of chalk was still carbonate of lime: if that is so, tell me of how many things the molecule of carbonate of lime consists. Ans.—Three. Yes. What are they? Ans.—Calcium, oxygen, and carbon. Now, remember what I told you in my last lesson, and tell me what we call those three things. Ans.—Elements. Yes; and what did I call such a substance as carbonate of lime? Ans.—A compound. Do you think you could see these very small divisions of calcium, oxygen, or carbon? No, sir. Why not? Ans.—Because they are smaller than the molecule, and we can only *conceive* of that: we can't *see* it. I will now write on the board a name for the smallest conceivable division of an element: the word 'atom.' You can tell me now the difference between a molecule and an atom. Ans.—A molecule is a division or very small part of a compound; but an atom is a division of an element. Yes. Tell me how many atoms there are in a molecule of carbonate of lime. Ans.—Three. Only three? (Another boy)—Five, sir. How do you make that out? Ans.—There are one of calcium, three of oxygen, and one of carbon. Jones, come and write out the symbol for a molecule of water. Ans.—H_2O. Yes. How many atoms have we here? Ans.—Three. Two of hydrogen and one of oxygen. Now, boys, take out your books and write out these definitions:—A particle is a very small division of matter, but not too small to be seen. A molecule is the smallest conceivable division of a compound. An atom is the smallest conceivable division of an element. (End of lesson.)

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'How I Teach Arithmetic.'

(*Continued from page* 274.)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

Having performed the mechanical multiplying, we settle the positions of the points by the rule as above; but besides settling the position of the point by *rule*, it is well to encourage a *rational* consideration of the result—where the point *must* be according to reason.

In the first exercise we are multiplying nearly a half (·48075) by a little over a half (·605), hence the result must be about a quarter, a little over a quarter being what we have really obtained (·29085375). Show that the point being in any other position would be irrational, as ·029 +, 2·908 +, 29·08 +, etc. In the second exercise it might be observed that we are multiplying $8\frac{1}{2}$ nearly by about (a little over) $\frac{1}{16}$, and the product must be a little more than a half, as the result shows. In the third example we are multiplying a little over a thirtieth by a little over a third, the consequent product must therefore be somewhat over a ninetieth. Carefully consider the given result—·01225, and show that it is over a ninetieth, being nearly an eightieth, and that the point in any other position would give nonsense.

(*d*) The effective teaching of *Division* of decimals requires more labour and patient painstaking than any of the three preceding rules, requiring more penetration on the part of the learner than is required to comprehend the principle of addition and subtraction, or the rule for the position of the point in multiplication. In this case, contrary to our general practice, instead of reasoning strictly *a priori*, as we have hitherto done and shall continue to do generally, we will elucidate to some extent by the *posteriori* method, accepting the rule and explaining its universality. The general rule for the position of the point—*the quotient must have as many decimal figures as the dividend has in excess of the divisor*, we will illustrate by examples. Divide ·625 by ·25, = 2·5,—because ·625 (625 thousandths ÷ 25 hundredths or 250 thousandths) ÷ ·250 = $2\frac{1}{2}$ = 2·5; hence the quotient (2·5) has one decimal figure, being the excess that the dividend has over the divisor.

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                                  ·552
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We will remark on each of the two above worked-out examples. In the first example, having worked out all the figures given, precisely as if they were whole numbers, we obtain a quotient of 390, and a remainder of 25. We now settle the point according to the rule, quoted above, placing it between the 9 and the 0 = 39·0. We now bring down additional ciphers *ad libitum*, that is virtually adding them to the dividend, and consequently each will give an additional figure to the quotient. We proceed thus till the quotient either comes out, repeats or circulates, or till we have carried the result to a sufficient degree of minuteness. We will now consider the answer obtained, 39·02. We observe that the divisor is just $\frac{1}{8}$, and the dividend nearly 5, and nearly 5 divided by $\frac{1}{8}$ must be *about* 40. Here show that any other position of the point would give an absurdity: 3·902, ·3902, 390·2, etc.

In the second example worked out above we first perform the mechanical operation on the figures given, and obtain the figure 7 as the result. Applying the rule, we find that the quotient must have *three* decimal figures, consequently we must make up the number by adding two ciphers to the left of the 3, giving ·007. Although repeatedly cautioned that ciphers to the *right* of a decimal do not at all affect its value, some of the poorer thinkers would probably give ·700 as the result. Now complete the working by bringing down as many ciphers as are thought necessary to complete the quotient, placing a + to the right to show that it does not come out clear. We will now settle the point rationally. We are dividing a little less than $\frac{1}{20}$ by nearly 7. As ·4875 is nearly $\frac{1}{2}$, ·04875 is nearly $\frac{1}{10}$ of $\frac{1}{2}$, or $\frac{1}{20}$; and $\frac{1}{20}$ divided by nearly 7 must give about $\frac{1}{140}$, certainly it must be less than $\frac{1}{100}$ or ·01, hence there must be two ciphers before the 7. As before, show that the point cannot according to common sense be in any other position, by trying other positions, and remarking accordingly.

Examples should be given requiring the point to be in every conceivable position, and its position determined both by rule and reason. Divide ·000007 by ·00035 = ·02; ·03654 ÷ ·000018 = 2030; 21973 ÷ ·0073 = 3,010,000; ·0046178 ÷ 380 = ·00001215 +; etc.

(*e*) In *converting vulgar fractions into decimals* we are only following the principle just laid down with regard to division. Thus, $\frac{3}{5}$ = (3 ÷ 5) = ·6, as a cipher must be added to the 3 in order that 5 may go in it, hence the result ·6, not 6. Again, $\frac{4}{25}$ = (4 ÷ 25) = ·16; $\frac{7}{125}$ = (7 ÷ 125) = ·056; etc. Hence the rule, *Add ciphers to the numerator, and divide by the denominator.* Caution here that a cipher will be required in the decimal obtained for every cipher added to the numerator until a vital figure is obtained. In the last example, as 125 will not go in 7·0, the result is ·056, not ·56, which, being more than $\frac{1}{2}$, would be absurd; and $\frac{3}{40000}$ = ·000075, $\frac{7}{2014}$ = ·0034 +, etc.

(*f*) Bringing *a decimal fraction of a higher denomination to its integral value in lower denominations* is such a simple process as to call for few remarks. In fact it is only acting out the dictum we have previously uttered, that decimal numbers may be worked precisely as whole numbers. Examples: Find the value of £·7875, of ·02375 ton, and of ·00885 of £150.

```
£  ·7875         ton. ·02375           ·00885
      20                  20              150
   -----              ------          -------
s. 15·7500       cwt.  ·47500      £ 1·32750
      12                   4               20
   -----              ------          -------
d.  9·00          qr. 1·9000       s. 6·5500
                          28               12
                      ------          -------
                  lb.  25·2        d. 6·60
```

Hence the three answers are respectively 15s. 9d., 1 qr. $25\frac{1}{5}$ lb., and £1 6s. $6\frac{3}{5}$d. In the second example we have brought the decimal of a ton to cwts., no whole ones, then this decimal of a cwt. to quarters, and lastly the ·9 qr. to lbs.

(*g*) We now take the exact converse of this operation, and *bring a number, either integral or decimal, of a lower denomination to the decimal of a higher denomination.* As explanatory examples we will take the reverse of the first two of the three just worked out. Bring 15s. 9d. to the decimal of a £, and 1 qr. $25\frac{1}{5}$ lb. to the decimal of a ton.

```
      (1)                      (2)
 12)9·00 d.              28)25·2 lb.
 20)15·75 s.              4)1·9 qr.
    £·7875 Ans.          20)·475 cwt.
                            ·02375 ton.  Ans.
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Here, in the first example, we have first brought the 9d. to the decimal of a shilling = ·75s., to the left of which we have placed the 15 shillings, giving 15·75s., which divided by 20 gives the required result. The second example needs no further explanation. Further examples: Bring 1s. $3\frac{3}{4}$d. to the decimal of £500, and bring 5 days 11 hrs. 27·6 mins. to the decimal of a week.

(3)	(4)
4)3·0 farthings.	60)27·6 mins.
12)3·75 pence.	24)11·46 hrs.
20)1·3125 s.	7)5·4775 days.
500)·065625 £.	Ans. ·7825 week.
·00013125 Ans.	

A boy who could manipulate decimals pretty readily would make short work of example 3: he would simply put down the 3·75 pence, divide it by 12, giving ·3125s., affix the whole shilling, = 1·3125s., and then divide by 10,000, the number of shillings in £500; that is, he would move the point four places to the left, and obtain the correct result. Example 4 can be followed without any further remarks.

(h) We will now consider *repeating* or *recurring* decimals. We find in bringing some vulgar fractions to decimals that the result does not terminate, but either repeats the same figure, or a group of the same figures; thus $\frac{1}{3}$ becomes ·333, etc., and $\frac{3}{7}$ becomes ·428571 recurring. When the same single figure recurs it is called a *repeating* decimal, and when the same batch of figures recurs it is called a *circulating* decimal. This recurring is expressed by placing a point vertically over a repeater, and over the first and last figures of a circulator; thus the above are expressed $\cdot\dot{3}$ and $\cdot\dot{4}2857\dot{1}$ respectively. When the recurring figures commence immediately from the point they are called pure recurrers as the above, and when one or more figures intervene between the point and the recurring figures they are called impure or mixed; thus $\cdot 8\dot{3}$ is an impure repeater, and $\cdot 76\dot{4}5\dot{3}$ is an impure circulator.

As recurring decimals are often turned into vulgar fractions in order to be more easily worked, or for any other purpose, we will take a few examples. First show that a pure recurrer has 9 or a succession of nines—99, 999, etc.—for its denominator, the recurring figures themselves being the numerator; thus, $\frac{1}{3} = \frac{3}{9} = \cdot\dot{3}$, $\frac{5}{11} = \frac{45}{99} = \cdot\dot{4}\dot{5}$, etc. For the conversion of an impure recurrer to a vulgar fraction I shall simply state the ordinary rule, referring the reader for its theory to any of the standard arithmetics—Colenso's, Fitch's, Barnard Smith's, Mansford's, etc. We will quote the rule, and apply it. Subtract the part that does not repeat from the whole for the numerator, and for the denominator place a cipher (to the right) for every non-repeating figure, and a nine for every repeating figure; *e.g.*, bring $\cdot 8\dot{3}$ to a vulgar fraction: $83 - 8 = 75$ the numerator, 90 will be the denominator, hence we have $\frac{75}{90} = \frac{5}{6}$. Bring $\cdot 4\dot{8}\dot{6}$ to a vulgar fraction: $486 - 4 = 482$ for numerator, and 990 for denominator, hence $\frac{482}{990} = \frac{241}{495}$. Bring $\cdot 34\dot{7}4\dot{9}$ to a vulgar fraction: $34749 - 34 = 34715$ the numerator, and 99900 the denominator, hence $\frac{34715}{99900} = \frac{6943}{19980}$.

Although the most common device for working recurring decimals is to convert them into vulgar fractions, other devices are also resorted to, such as in multiplying a repeater 'carrying' the number of *nines* instead of tens, and in multiplying circulators of two, three, or more figures, carrying respectively the number of 99's, 999's, etc.

(i) The teaching of decimals would be incomplete did we not consider some system of *Decimal Coinage*, a subject which has commended itself to the favourable consideration of a large proportion of the more intelligent of the commercial community for many years, but which hitherto has only received the cold shoulder from statesmen in power, under the plea that the people are not yet equal to the change educationally; a plea of twenty years' standing at least, to my certain knowledge. When brought again to the front in May last, in connection with the Metric System of Weights and Measures, to which we will not further refer at the present, it was more cavalierly and curtly treated than usual. My own impression is that it might be advantageously introduced at once, and that the little inconvenience at first to the uneducated would soon be overcome. Two systems have received consideration, the first making the £ the unit or basis, and the latter the penny. As the former is undoubtedly the preferable, and the more favourably received generally, it only is generally taught in schools.

In giving a first lesson I put down on the board (say) £1·111, and remark that here we have £1 + £$\frac{1}{10}$ + £$\frac{1}{100}$ + £$\frac{1}{1000}$. I now suppose that we wish to represent these different items each by a separate coin. Well, we have the sovereign, and we have also the florin = £$\frac{1}{10}$. Hence we have already, without any addition to or alteration in our coinage, two out of the four coins we require. We now want another coin, to be £$\frac{1}{100}$ or $\frac{1}{10}$ florin, which it is proposed to call a *cent*, = $2\frac{2}{5}$d. or 2·4d., and which, if made of silver, would be somewhat less than a threepenny piece, but if made of bronze (copper), nearly $2\frac{1}{2}$ times the size of a penny. The mechanical difficulty—being too small or too large—might, however, be overcome by making it of an alloy, or better still, perhaps, by silver embedded in bronze. As this matter does not, however, affect the ostensible objection—educational deficiency—we proceed to the next required coin. We now require a coin to be worth £$\frac{1}{1000}$, $\frac{1}{100}$ florin, or $\frac{1}{10}$ cent, which has received the name *mil.* As 960 farthings = £1, a mil would be a little less in value, just $\frac{24}{25}$ of one. The farthing, where not obsolete as it is fast becoming as a circulating coin, might still remain current as a mil, since the commercial price of copper varies far more from year to year, or much shorter intervals, than the difference between a farthing and a mil. Examples: Read off (1) £8·625, (2) £·7485, (3) £·08475, (4) £·007625, in decimal coinage. (1) Here we have 6 tenths or *florins*, 2 hundredths or *cents*, and 5 thousandths or *mils;* hence the total is £8 – 6 fls. 2 cts. 5 mils. (2) 7 fls. 4 cts. $8\frac{1}{2}$ mils. (3) 8 cts. $4\frac{3}{4}$ mils. (4) 7·625 mils. = $7\frac{5}{8}$ mils.

Hence to convert any amount from current money (£ s. d.) to decimal coinage, we have only to express the amount decimally in £'s, as explained under *(g)*, and then read off as above. Thus 18s. $4\frac{1}{2}$d. = £·91875 = 9 fls. 1 ct. $8\frac{3}{4}$ mils.; 2s. $8\frac{1}{4}$d. = £·134375 = 1 fl. 3 cts. 4·375 (or $\frac{3}{8}$) mils.

To convert decimal coinage into present money is so self-evident that a boy of ordinary capacity would do it of his own accord. 8 fls. 5 cts. 5 mils. = £·855 = 17s. $1\frac{1}{5}$d.; 4 fls. 8 cts. $7\frac{3}{4}$ mils. = £·48775 = 9s. 9·06d. = 9s. $9\frac{3}{50}$d.

(To be continued.)

PROPOSALS FOR REVISION OF CODE.

GENERAL.

The references in brackets [ ] are the Articles of the existing Code affected by the changes.

[Article 19 B]—1. It is proposed to adopt the average attendance in each school as the basis of the grants which have hitherto been made on account of individual scholars, whether infants (under 7 years of age) presented to H.M. Inspectors for collective examination, or children above 7, presented for examination in reading, writing, and arithmetic.

2. 250 attendances will be no longer required as a condition of examination, but all scholars who have been on the registers for six months will (unless there is a reasonable excuse for their absence) have to be presented to the Inspector.

3. The grants will be so assessed that the present average rate of aid will, as far as possible, be maintained.

The rate at which each item of the grant will be assessed cannot yet be stated. It is also desirable that, for the present, attention should be directed to the educational, rather than to the financial, effects of these proposals.

GRANTS COMMON TO ALL SCHOOLS.

4. *Music.*—The full grant will be paid if singing is satisfactorily taught from notes, or according to the Tonic Sol-fa system. One half only will be paid if singing is taught by ear.

5. *Sewing*, according to the revised needlework schedule (*annexed hereto*), will be compulsory for all girls, and for boys below seven years of age. A special grant will be made, calculated on the average attendance.

6. *Special Merit.*—The Inspector shall have regard to (*a*) the organisation and discipline; (*b*) the employment of intelligent methods of instruction; and (*c*) the general quality of the work in each school, especially in the Standard examination; and shall have power to recommend an additionel grant on the average attendance, varying in amount according as the schcol is, in these respects, fair, good, or excellent.

INFANT SCHOOLS.

7. All grants save those for pupil teachers (Article 19 E of the present Code) will be based on the average attendance.

8. When the infants in a school amount to 40, a separate adult teacher will be required for their instruction. For more than 60 infants a certificated teacher will be required.

9. Part of the grant for infants will be made to depend upon their being taught by special methods, providing for—
(1) Appropriate and varied occupations.
(2) Suitable instruction in the rudiments of reading, writing, and arithmetic; and
(3) A systematic course of simple lessons on objects, and on the phenomena of nature and of common life.

10. Infants, between six and seven, may, at the discretion of the Inspector, be examined individually according to Standard I. of the Code of 1870.

11. If any scholars in an infant school are taught in Standard I. they will be examined and paid for as in schools for older children.

[*Standard I., Code* 1870. *Reading.*—Narrative in monosyllables. *Writing.*—Form on black-board or slate, from dictation, letters, capital and small, manuscript. *Arithmetic.*—Form on black-board or slate, from dictation, figures up to 20; name at sight figures up to 20; add and subtract figures up to 10; orally, from examples on black-board.]

BOYS' AND GIRLS' SCHOOLS.

[Article 19 B.]—12. Payments on the passes of individual scholars will be abolished; and 250 attendances will no longer be required as a condition of examination.

13. All scholars on the registers are to be present at the inspection, unless there is a reasonable excuse for absence; and all such children, who have been six months and upwards on the registers, are to be presented for examination.

14. The grant will be calculated on the results of the examination of these scholars. It will be based upon the proportion of passes actually made to those that might have been made by the scholars examined.

15. The Inspector will examine—
(*a*) All scholars presented in the standard, fixed by the bye-laws of the district, for half-time labour.
(*b*) All scholars presented in Standard III., and upwards.
(*c*) Any child, whether a scholar in the school or not, who desires to pass in either of the standards fixed by the bye-laws of the district, for total or partial exemption from attendance at school.
(*d*) In Standards I. and II. (unless either of these is the standard for half-time labour) such a number of scholars as will enable him to estimate the quality of the instruction in each of the three elementary subjects.

16. A *Seventh* Standard is introduced. (*See Examination Schedule annexed hereto.*)

17. If any scholar over ten years of age is, after the 1st of April, 1883, presented in the 1st or 2nd Standard, the passes made by such scholar will not be reckoned in calculating the percentage of passes for the purpose of a grant.

CLASS SUBJECTS.

18. A school will be regarded as made up of two divisions:—
In the lower division—Standards I.-IV.
In the upper division—Standard V. and upwards.

19. Two class subjects may be taken up in each division.

20. English (grammar and recitation), geography (including physical geography), and elementary science will alone be recognised as class subjects in the lower division.

21. If only one class subject is taken, in the lower division, it shall be English; if two are taken, the second shall be either geography or elementary science.

22 *History.*—One of the reading-books in use in each Standard, from the third upwards, must be an historical reading-book, adapted to the ages of the scholars in the standard.

23. The upper division may take, as class subjects, any of the three subjects to which the lower division is restricted, or history, or a specific subject.

[Article 19 C.]—24. The grant for class subjects will be made, as now, on the average attendance, and an increased grant will be paid if 20 per cent. of the scholars examined are presented in Standard IV. and upwards.

SPECIFIC SUBJECTS.

25. The following will be specific subjects:—1. Algebra; 2. Euclid; 3. Mechanics; 4. Latin; 5. French; 6 Animal Physiology; 7. Botany; 8. Principles of Agriculture; 9. Domestic Economy.

26. English and Physical Geography are removed to the category of class subjects. Algebra and Euclid are separated. The Principles of Agriculture are added to the list of specific subjects.

The Principles of Agriculture will also be made an optional subject in the course of instruction for—1. Pupil Teachers; 2. Students in training colleges.

27. These subjects will not be begun before the Fifth Standard. The examination and payments will be individual.

28. No scholars will be examined in specific subjects, if the percentage of actual to possible passes in the elementary subjects at the previous inspection was less than 75, and no grant will be paid if the same percentage is not reached at the close of the year for which the grant is claimed.

[Article 21 *f*] 29. Domestic economy will no longer be required to be taken up by girls as a condition of being examined in specific subjects.

NIGHT SCHOOLS (ARTICLE 22).

30. Grants will no longer be confined to reading, writing, and arithmetic, but will be made also for proficiency in class subjects.

31. Grants will be paid in respect of those children only who, having passed the standard fixed by the bye-laws of their district for total exemption, are under no obligation to attend school, and are not day scholars.

[Article 42]—32. The teacher of a night school need not be a layman.

TEACHERS.

[Article 19 E.]—33 The special grants to pupil teachers for proficiency at their annual examinations will be continued.

[Article 70 *g.*]—34. Not more than three pupil teachers will be allowed in any school or department, whatever number of certificated teachers may be employed in it.

35. Stipendiary monitors will no longer be recognised. Candidates for engagement as pupil teachers will be required to pass in Standard V. or VI., with some elementary knowledge of grammar and geography.

[Article 32 *c.*]—36. In calculating the staff of a school, an assistant teacher will count as sufficient for sixty scholars, instead of eighty as heretofore.

37. No teacher examined at, or after, Christmas 1882 will be allowed to have pupil teachers who has not passed in the papers of the *second* year. A candidate who takes *first* year's papers will not obtain a certificate above the *third* class. He will be

allowed to be re-examined, in second year's papers until he obtains a higher certificate, but not more than once every three years.

38. The annual entries made by the Inspectors on teachers' certificates will be discontinued after they have been raised to the first class. To enable a teacher to present to school managers, who wish to employ him, a record of his services after he has reached the first class, he will be entitled to claim, from the managers of his school, a certificated copy of the Inspector's yearly report when it is entered in the log-book.

[Article 79.]—39. Graduates of any University in the United Kingdom, and women who have passed certain of the higher examinations held by the Universities, may be recognised as assistant teachers, and will be admissible to examination for certificates, after serving as assistants for one year in a school under inspection, if the Inspector reports favourably of their skill in teaching, reading, and needlework (*women*).

40. Certificates will no longer be granted without examination under Article 59 of the Code.

[Article 69.]—41. No certificate will be cancelled, suspended, or reduced until the department has informed the teacher of the charges against him, and has given him an opportunity of explanation.

MISCELLANEOUS.

[Article 19.]—42. Honour certificates, and the payment of the fees of children who hold such certificates, will be discontinued.

[Article 19.]—43. The production of a Child's School Book will no longer be required as a condition of the payment of annual grants.

Education Department, F. R. SANDFORD.
5th August, 1881.

SCHEDULES.

STANDARDS OF EXAMINATION IN ELEMENTARY AND CLASS SUBJECTS.

Article 28.

*Reading.—Standard I.—To read a short paragraph from a book not confined to words of one syllable. Standard II.—To read a short paragraph from an elementary reading book. Standard III.—To read a passage from an advanced reading book, or from stories from English history. Standard IV.—To read a few lines of poetry or prose, from a reading book, or history of England, used in the School. Standard V.—To read a passage from some standard author, or from a history of England. Standard VI.—To read a passage from one of Shakespeare's historical plays, or from a history of England. Standard VII.—To read a passage from Shakespeare or Milton, or from a history of England.

†Writing.—Standard I.—Copy in manuscript characters a line of print, and write from dictation ten easy words, commencing with capital letters. Copy books (large hand) to be shown. Standard II.—A passage of not more than three lines, from the same book, slowly read once, and then dictated word by word. Copy books (large and half-text hand) to be shown. Standard III.—Six lines from one of the reading books of the standard, slowly read once, and then dictated. Copy books (capitals and figures, large and small hand) to be shown. Standard IV.—Eight lines of poetry and prose, slowly read once, and then dictated. Copy books to be shown. Standard V.—Writing from memory the substance of a short story read out twice; spelling, handwriting, and correct expression to be considered. Copy books to be shown. (N.B.—An exercise in dictation may, at the discretion of the inspector, be substituted for composition.) Standard VI.—A short theme or letter on an easy subject; spelling, handwriting, and composition to be considered. Copy books and exercise books to be shown. Standard VII.—A theme or letter; composition, spelling, and handwriting to be considered. Note books and exercise books to be shown.

‡Arithmetic.—Standard I.—Notation and numeration up to 1,000. Simple addition and subtraction of numbers of not more than three figures. In addition not more than five lines to be given. The multiplication table to 6 times 12. Standard II.—Notation and numeration up to 100,000. The four simple rules to short division. The multiplication table and the pence table to £1. Standard III.—The former rules, with long division. Addition and subtraction of money. Standard IV.—Compound rules (money) and reduction of common weights and measures § Standard V.—Practice, bills of parcels, and rule of three by the method of unity. Addition and subtraction of proper fractions, with denominators not exceeding 20. Standard VI.—Fractions, vulgar and decimal; proportion and interest. Standard VII.—Averages, percentages, discount, and stocks.

* Reading with intelligence will be required in all the standards, and increased fluency and expression in successive years. Three sets of reading books should be provided in each standard; of which, after Standard II., one should relate to English history. The Inspector may examine from any of these books. The intelligence of the reading may be tested partly by questions on the meaning of what is read.

† The writing and arithmetic of Standards I. and II. may be on slates or paper, at the discretion of the managers; in Standard III. and upwards it must be on paper.

‡ The work of girls will be judged more leniently than that of boys, and the Inspector may examine scholars in the work of any Standard lower than that in which they are presented, and in mental arithmetic suitable to their respective Standards The object of the exercise in mental arithmetic is to encourage dexterity and correctness in computation; and to anticipate, by means of rapid and varied oral practice with small numbers, the longer problems which have to be worked out in writing in the following year. Such exercises should, from the first, deal with concrete as well as with abstract numbers.

§ The 'weights and measures' should be such only as are really useful—*e.g.*, avoirdupois weight, long measure, liquid measure, time measure, square and cubical measure, and any measure connected with the industrial occupations of the district in which the school is situated.

* CLASS SUBJECTS.—Article 19 C.

I. English.—Standard I.—To learn by heart 20 lines of simple verse, and to know their meaning. Standard II.—To learn by heart 40 lines of poetry, and to know their meaning. To point out nouns and verbs. Standard III.—To recite with intelligence and expression 60 lines of poetry. To point out nouns, verbs, adjectives, adverbs, and personal pronouns, and to form simple sentences containing them. Standard IV.—To recite 80 lines of poetry, and to explain the words and allusions. To parse simple sentences, and to illustrate the use of each of the parts of speech. Standard V.—To recite 100 lines from some standard poet, and to explain the words and allusions. To parse and analyse simple sentences, and to know the method of forming English nouns, adjectives, and verbs from each other. Standard VI.—To recite 150 lines from Shakespeare or Milton, and to explain the words and allusions. To parse and analyse complex sentences, and to know the meaning and use of Latin prefixes in the formation of English words. Standard VII.—To recite 200 lines from Shakespeare or Milton, and to explain the words and allusions. To analyse sentences, and to know prefixes and terminations generally.

II. Geography.—Standard I.—The meaning and use of a map. A plan of the school and playground. The four cardinal points. Standard II.—The size and shape of the world. Geographical terms simply explained, and illustrated by reference to the map of England. Physical geography of hills and rivers. Standard III.—Physical and political geography of England, with special knowledge of the district in which the school is situated. Standard IV.—Physical and political geography of the British Isles, British North America, and Australasia, with knowledge of their productions. Standard V.—Geography of Europe, physical and political. Latitude and longitude. Day and night. The seasons. Standard VI.—Geography of the world generally. Interchange of productions. Circumstances which determine climate. Standard VII.—The ocean. Currents and tides. General arrangement of the planetary system. The phases of the moon. [In Standards V., VI., and VII., maps and diagrams may be required to illustrate the answers given.]

III. Elementary Science (a course of simple lessons on).—Standard I.—Animals and common objects. Standard II.—The colours and shapes of familiar objects; the uses of common substances employed in the arts and manufactures; and the habits of domestic animals. Standard III.—(*a*) Animals and plants, *or*, (*b*) Some simple machines, *or*, (*c*) The properties of air and water. Standard IV.—(*a*) General comparison of the chief classes of quadrupeds, *or* (*b*) The processes employed in one of the chief industries in England (of which agriculture may be reckoned for this purpose as one), *or*, (*c*) Light and heat. Standard V.—(*a*) General comparison of the chief divisions of the animal kingdom, *or*, (*b*) The processes employed in two of the chief industries of England (of which agriculture may be reckoned for this purpose as one), *or*, (*c*) Gravitation, weight, and specific gravities. Standard VI.—(*a*) Distribution of plants and animals, *or*, (*b*) The common pump, barometer and thermometer, pulleys, and levers, *or*, (*c*) The laws of motion. Standard VII.—(*a*) The races of mankind, *or*, (*b*) The construction of the steam engine, and its application to agriculture or manufactures, *or*, (*c*) Some of the ordinary chemical combinations of frequent occurrence in nature.

NEEDLEWORK SCHEDULE.

GIRLS' AND INFANTS' DEPARTMENTS.

BELOW STANDARD I.

Boys and Girls.

Needle drill.—Position Drill.
Strips (18 inches by 2 inches) in simple hemming with coloured cotton, in the following order, viz.:—1. Black. 2. Red. 3. Blue.
Knitting-pin drill.
A strip knitted (15 inches by 3 inches) in cotton *or wool.*

STANDARD I.

1 Hemming, simple *or counter*, seaming, felling, *plaiting*. Any garment which can be completed by the above stitches, *e.g.*, a child's plain shift or pinafore.

2. Knitting. 2 needles, plain and purled, *e.g.*, a strip on which to teach darning in Girls' Upper Standards, or a comforter or muffatee.

STANDARD II.

1. The work of the previous Standard with greater skill, and sewing on strings. Garment, an apron, pinafore, or plain shift plaited into a band.
2. Knitting. 4 needles, plain and purled, *e.g.*, wristlets or muffatees.

STANDARD III.

1. The work of the previous Standards with greater skill, and in addition, stitching garment, a shift or apron plaited into a stitched band.
Herring-bone stitch. The stitch only on coarse canvas (cheese cloth) or flannel.
Darning, simple. } On cheese cloth or calico.
Marking, simple. }

2. Knitting. 4 needles, *e.g.* a sock.

STANDARD IV.

1. The work of the previous Standards with greater skill, and, in addition, gathering, stroking, setting-in, *herring-bone*, marking, button-hole, sewing on button. Garment, a plain night shirt, night gown, petticoat, or child's frock, either in calico, coloured shirting, or flannel.
2. Darning, plain (as for thin places), in stocking-web material and woven fabric.
3. Knitting. 4 needles, a man's sock or girl's stocking.

STANDARD V.

1. The work of the previous Standards with greater skill, and, in addition, tuck run. Garment, a night gown or child's frock.

* The children in Standards V., VI., and VII. may, if grouped together for teaching be examined in one or two groups, and each such group may be examined in the subjects fixed by the schedule for any one of the Standards included in it, provided that the subjects chosen for the examination of each group shall follow one another in regular order from year to year.

If any other class subjects are taken for the examination in Standard V. and upwards, a graduated scheme of teaching them must be submitted to the Inspector, and approved by him at the previous inspection.

2. Knitting. 4 needles, a knickerbocker stocking.
3. Darning, simple, and a hole in stocking-web material.
4. Patching in calico and flannel.
5. Cutting out any garment such as a child in Standard III. can make up.

STANDARDS VI AND VII.

1. The work of the previous Standards with greater skill, and whip stitch, setting-on frill, *knotting*, coral-stitch (feather-stitch). Garment, a night dress with frill, or baby's robe, or child's fancy pinafore.
2. Darning, plain and Swiss, and grafting on stocking-web material.
3. Patching and darning on woven fabrics, *e.g.*, calico, flannel, serge, &c.
4. Knitting. 4 needles, a long stocking with heel thickened.
5. Cutting out any under-garment suitable for making up in Standard IV.

NOTES.

1. The work printed in *italics* is optional.
2. Boys below seven, in Infant Departments, must do the same work as the girls.
3. Counter-hem is not necessary where seaming can be done.
4. Garments must be shown in each stage, but not necessarily those specified in this Schedule, which are mentioned merely as examples. They must be presented in the same condition as when completed by the scholars.
5. A garment made by more than one child may be presented, provided that as many garments are shown as there are girls examined.
6. Girls should fix their own work in the earlier stages, and must do so in the fourth and higher stages.

Pupil Teachers (Girls).

Pupil teachers of the first year will be expected to work well, and to be able to teach all that is required in the first three standards, and to advance a standard in each successive year of their engagement. Some further special work will hereafter be prescribed for pupil teachers each year.

FIRST SCHEDULE.

QUALIFICATIONS AND CERTIFICATES OF PUPIL TEACHERS AT ADMISSION AND DURING THEIR ENGAGEMENT.

Candidates for pupil teacherships must be not less than fourteen years of age, must be presented to the Inspector on the day of the school examination, and must pass satisfactorily in the Fifth or Sixth Standard, and in the elements of grammar and geography. They must produce medical certificates that they are not subject to any infirmity likely to interfere with their duties as teachers; and also certificates from the managers of the school of good conduct and character. Similar certificates of health will be required at the end of the second year, and certificates of conduct and character at the end of each successive year.

End of First Year.

Reading and Repetition.—To read with fluency, ease, and just expression, and to repeat 50 lines of poetry. English grammar and composition.—Parsing and analysis of simple sentences, with knowledge of the ordinary terminations of English words. Writing from memory the substance of a passage of simple prose, read with ordinary quickness. Arithmetic and mathematics.*—Boys: Vulgar and decimal fractions, with their applications. Girls: Practice, tradesmen's and household accounts. Measures and multiples, with addition and subtraction of vulgar fractions. Geography†.—The British Islands, Australia, and British North America. Physical geography of mountains and rivers. (Maps to be drawn in this and the following years.) History†.—Outlines of British history, from Julius Cæsar to the Norman Conquest. Teaching.—To conduct a class in reading, writing, or arithmetic.

End of Second Year.

Reading and Repetition.—To read as above, and to recite 80 lines of poetry, with knowledge of meanings and allusions. English grammar and composition.—Parsing and analysis of sentences, with knowledge of the chief Latin prefixes and terminations. Paraphrase a short passage of poetry. Arithmetic and mathematics*.—Boys: Proportion, with its applications to interest, averages, percentages, and stocks. Geometry to Prop. XXVI. of Euclid, Book I. Girls: Vulgar fractions, with their applications to money, weights, and measures. Reduction of vulgar fractions to decimals. Geography†.—Europe and British India. Climate and productions of the British possessions. History.†—From the Conquest to the accession of the Stuarts. Teaching.—To conduct a class in reading, writing, or mental arithmetic (in an infant school on form, colour, number, or some familiar object).

End of Third Year.

Reading and Repetition.—To read as above, and to recite 100 lines of poetry, with knowledge of meanings and allusions. English grammar and composition.—Parsing, analysis, and paraphrase of complex sentences. Prefixes and affixes generally. Knowledge of the simple tests by which English words may be distinguished from those of foreign origin. Arithmetic and Mathematics.*—Boys: Arithmetic, generally, including the extraction of the square root, mensuration of triangles and parallelograms. Euclid, Book I. Algebra to simple equations (inclusive). Girls: Decimals and simple proportion. Geography†.—Asia and Africa. Latitude and longitude. Winds and tides. History†.—From the accession of the Stuarts to the present time. To conduct a class in grammar or geography (in an infant school on form, colour, number, or some familiar object), and to prepare notes of a lesson.

End of Fourth Year.

To read as above, and to recite 100 lines of Shakespeare or Milton with clearness and force, and knowledge of meanings and allusions. *N.B.*—The passages for repetition must be of a secular character, and taken from some standard English writer approved by H.M. Inspector. The meanings and allusions, if well known, will atone for deficiencies of memory. English grammar and composition.—Fuller knowledge of grammar and analysis, and of the common Latin roots of English words. Outline of the history of the language and literature. Arithmetic and mathematics*.—Boys: Arithmetic. Euclid, Book II. Mensuration of plane surfaces. Algebra to quadratic equations (inclusive). Girls: Application of fractions and proportion to interest, discount, percentages, averages, and stocks. Geography†.—The world generally. The seasons, the sun, moon, and planetary system. History†.—The same period in fuller detail. Teaching.—To give a collective or class lesson on any subject taught in the school. To prepare notes of a lesson.

N.B.—In all the subjects questions may be given on the work of the previous years.

* The papers on arithmetic may contain questions requiring the reasons of the several rules to be explained and demonstrated as to a class of scholars.

† Pupil teachers may take the geography and history in any order which may be most convenient to the principal teacher in instructing them, provided that the requirements of all four years are fulfilled during the term of their engagement.

‡ On the occasion of H.M. Inspector's visit to the school, pupil teachers must be prepared to afford evidence of their skill in teaching needlework by a lesson given in his presence.

N.B.—Columns 9 (Additional Subjects), 10 (Drawing), and 11 (Music), will remain as at present, except that in column 9 the Principles of Agriculture will be added to the list of additional subjects, in which pupil teachers may be presented at the May examinations of the Science and Art Department.

SPEECH OF

THE RIGHT HON. A. J. MUNDELLA, M.P.,

(Vice-President of the Committee of Council on Education),

Upon Introducing the

'PROPOSALS FOR A NEW CODE'

In the House of Commons, on Monday, August 8th, 1881.

I BEG to thank the House for allowing me to make my statement with the Speaker in the chair. My reason for asking this favour of the House is twofold. Not for the sake of the estimates which I am able to submit to the House, and which I should be quite prepared to submit in the usual way. But it will be in the recollection of the House that in the other House of Parliament, when the Code under which the conditions of the grant for education are made was carried, a distinct pledge was given to both this and the other House of Parliament that before the close of this Session we would submit proposals for the reform of the Code, and it is upon that ground, before going into Committee of Supply, that I shall make a double statement, the one relating to the ordinary business of the past year, and the proposed financial statement for the coming year, and the principles on which we propose to revise the Code. All that relates to the expenditure of the past year, I shall endeavour to condense into as short a space as possible, in order not to trespass upon the time of the House. The expenditure in 1880 was as follows:—The sum granted was £2,535,967, and the expenditure £2,525,769, the result being a saving of £10,308 upon the estimates. The charge for annual grants, which was estimated at £2,217,348, reached £2,213,673, an increase of £120,232 on the previous year, the details of which are as follows:—The estimate of average attendance was 2,800,480 children, and the actual average was 2,814,000, the estimated grant was 15s. 8d.; and the grant really made was 15s. 7½d. The estimate for the evening schools for the average attendance was 52,530 children and an estimate of 9s., and the result was 41,500 at 8s. 6¾d., a falling off in numbers of 11,000, and in the grant of 5d. in the year. Now, Sir, I come to the estimates that the House will be asked to vote to-night for the current year 1881-82. The sum required this year is £2,683,958, as compared with £2,535,967 granted in 1880-81. This is an increase of £147,991, and it produces a difference of £93,000 increase on the estimates of 1880-81. Although at first sight this difference will appear to be considerable, it will be understood that the increase in the expenditure was really an over-estimated expenditure in the year 1879-80. The increase on the vote for 1880-81 would have stood £140,000 instead of £55,000 on the estimates, therefore the increase on the estimates 1881-82 is £144,794, and it is a little more than an increase in the last year, which was really £140,000. The increase on the coming year 1881-82 occurs almost entirely under the head of annual grants. The amount of the votes is £2,362,142, an increase of £144,794 for the grant. It will be necessary that I shall show the House the expenditure for annual grants, and the comparison of this special head for the past three years shows that the increase asked for is not an extensive one. The annual grant made to the elementary schools in 1878-79 was £1,961,000, or an increase of £267,000 on the preceding year. In 1879-80 it was £2,093,000, or an increase of £132,000; in 1880-81 £2,213,000, or an increase of £120,000; and in 1881-82 it is £2,362,000, or an increase of £144,794. It will be noticed by the figures set forth that there is a very large increase in 1878-79, and

that was occasioned by the passing of the Act of 1876, which only came into practical operation in 1878-79. Amongst the other items there is an increase of £7,670 for expenditure this year caused by the addition of six inspectors and nine inspector's assistants, and by the usual number of inspectors being entitled to the increment. The inspectors were appointed after the details of the estimates had been made for last year, and they come into the present year. There is only one more item in reference to the expenditure that I ought to trouble the House with, and that is the building grant on the Act of 1870 for £670, and it is the last year of that grant. I now invite the House to consider the real educational progress of the past year. I may say before going into that part of the question, that there is no new or striking feature in the course of the year. There have been no new forces brought into operation during the year; we have been working steadily and quietly under the Acts of 1870 and 1876, and, as the Act of 1880 as to general compulsion did not come into operation until the 1st of January this year, the statement of progress that I have to make is the more gratifying, because the same steady, continuous, and unbroken progress of education has been going on since the passing of the Act of 1870. The principal features which I have to mention are as follows:—Accommodation is now afforded 4,240,000 children, showing an increase of 98,000 school places during the year; the scholars on the register 3,895,000, showing a remarkable increase of 185,000; scholars in average attendance 2,751,000, being an increase in attendance of 156,000 for the previous year; the scholars individually examined 1,904,000, being an increase of 144,000 in one year. The percentage of passing in the three R's, which is one of the real tests of the work done, is 81·2 as against 80·4 last year. They have now touched the highest point they have ever reached in the history of the Department. The proportion of scholars examined in Standard IV. and upwards, which is very interesting to several members, and my hon. friend the member for Wolverhampton, who I am glad to see in his usual place, is 24·61 as against 22·1 of last year, a very large amount indeed. We do not bring the children up to the higher standard; we are doing very little in the arrears of thorough education. I am as dissatisfied as any man in this House about them, but still it is gratifying to find this year that the proportion of scholars examined is increasing. Well, we have 41,426 masters, being nearly 3,000 more than heretofore, and we have 33,733 pupil teachers, and that gives an increase of 538. The cost for maintenance for scholars in Board schools is £2 1s. 11¾d., being a decrease of 1d. per head, and voluntary schools £1 14s. 7¾d., or an increase of 1¾d. per head. The rate of the grant earned is for Board schools 15s. 7¾d. per head, an increase of 4½d. on the previous year, and for voluntary schools 15s. 5d., or an increase of 1¾d. per head. It is the first time since the passing of the Act of 1870 that the Board schools have shown any substantial increase over the voluntary schools. Now in these figures there are two or three points we have of interest, and the first is the number of scholars on the registers. Although these have gone on increasing year by year from 1,693,000 in 1870 to 3,895,000 in the past year, it shows a substantial increase of 185,000 during the past year. Now the normal increase according to the growth of the population will be about 70,000 in the year, but we continue to receive into our schools nearly three times that increase every year, and at this moment that I am addressing the House, the probability is that there are over 4,000,000 of children on the registers of the schools, and we have every reason to expect that within the next ten years, when the Act of last year comes into full operation, the numbers will not be far short of 5,000,000 children. The next question to which I must call attention is that we have gone from 1,793,000 to above 4,000,000, and we are calculating on something like, after this year, a continual increase of 200,000 children a year. The average attendance has now reached 70·6, and this includes infants—the vast number of children who only attend half-time, and who are permitted by the School Board when they pass the standard to be employed half-time. If they were full time they would not detract very much from the average of the whole, and it must make a difference in the average of the year. Considering that every year we are passing in more of the children of their regular class, and that the compulsion reaches the more neglected of the lower classes, it is more satisfactory to find that the average attendance is higher to-day than it has ever reached before. This is an indication of real and substantial progress. We have not reached, by any means, what we hope to, and may, attain, and the best proof of that is what Scotland has already done. Scotland has already reached 76 per cent. average attendance, including half-time; and there is this to be said about Scotland, that the Scotch children go to school later, but stay later than the English children. That is owing to climate, and that infant schools are not so general as in England, and it is a most satisfactory result in the School Board in Scotland that they have already brought up the average attendance to 76 per cent. Now compulsion has done this. It succeeded in bringing a larger number of children to attend schools for at least a portion of their time, and has improved the average attendance to the point to which I have stated. I have a table here which shows that it has had the effect of causing a very considerable increase of the number of scholars who attend sufficiently regular to bring the grant to the schools. Out of every hundred scholars on the register in England and Wales there were 62 per cent., and they were qualified by attendance in the proportion of 40·2. In 1880, at the same stage, 68·3 on the register, and they were qualified by attendance to the extent of 52·2. This shows a number of children who get the grant in Scotland. I am bound to say the result is much better. They had been in 1874 64·9, and at the present moment they have reached 73·6, who make full school attendance. I am approaching that which I regard as the most satisfactory feature of the year, and that is the result of last year's examinations, and it is to this point I invite my hon. friend the member for Wolverhampton. The children examined did better in the three R's than in the previous year, the percentage of passes having risen from 80·4 to 81·2; whilst the proportion of scholars examined in Standards IV. to VI., compared with the total number of scholars individually examined, rose from 22·1 per cent. to 24·61 per cent. Now, in order to show the change which was gradually coming over our educational experience, I will ask the attention of the House to this fact, that the percentage of passes to the number of children examined fell steadily during the first six years after the passing of the Act of 1870. The number of ignorant and neglected children brought in, and the number of elder children who were unable to pass the standard, was so large that there was a steady fall in the percentage of passes throughout England and Wales. In 1872 the following were the percentages:—Passes in 1872, 81·1; in 1873, 80·8; in 1874, 80; in 1875, 79·7; in 1876, 78·8; and here in 1877 we ended the trouble. There had been a steady fall; then came the rise, and the recovery was due to this, that more attention was paid to the teaching of the infant children. The interest taken in the schools had begun to effect a great change in the children's passing in the upper standards, and the number of backward children grew less and less. In 1878 the number rose to 79·5; in 1879 to 80·4; in 1880, 81·2. This is the highest point at which the number has ever stood in Standards Four to Six. Now, the test is what do you pass in the upper schools? There are bye-laws and Factory Acts which affect these. The bye-laws and Factory Acts take half our children in the Fourth Standard out of schools every year. That is to say, that 50 per cent. of the children who pass the Fourth Standard in any year pass at once out of school. That is one reason why we cannot pass our children to the higher standards, because the standard of the Factory Act is the Fourth Standard, and the standards throughout the country, especially the rural districts, are from II. to IV. or III. to V. for half-time and full time respectively. The progress which had been made in the higher standards was one of the features in the year the most gratifying. I have made out statements which show the number of children presented in the higher standards since the passing of the Act of 1870. In 1870 the number who passed under the Old Code was 191,663 to all schools. Practically, it was 102,630 taking it as compared with the Code, as we have since that time raised the standards. In 1871 we have no record, because the Code changed. Then in 1872, 118,000; in 1873,

131,000, being an increase of 13,000; in 1874, 155,000, being an increase of 24,000; in 1875, 194,000, an increase of 39,000; in 1876, 234,000, an increase of 40,000; in 1877, 270,000, an increase of 36,000; in 1878, 324,000, an increase of 54,000; in 1879, 388,000, an increase of 64,000, and last year 468,000, an increase of 80,000 children in the upper standards. (Cheers.) The increased number passed through the upper Standards IV. to VI. since 1870 was more than 400 per cent. That is the best test of the work that is really being done. However well we may be doing with the English schools, the Scotch are doing better; and in Scotland this is much more remarkable than among ourselves. The numbers for Scotland—where they have had the compulsory system in full operation since 1872, while ours has just come into full operation—shows that in 1872 they passed 35,502 children, and they finished in 1880 by passing 102,259 in the upper standards; that is to say, out of 304,000, the average attendance was one-third of the whole, or 33 per cent. in Scotland, as against 24 per cent. in England. I should like to give a single illustration of the way the Scotchmen manage their schools, showing the wonderful results that are accomplished. I was struck with the case of a school which was placed in my hands some few months ago, and it gives an illustration of what could be done under the most adverse circumstances. It was a school in the village of Easdale, in the Island of Seil, in the county of Argyll. The chief industry of the place is slate-quarries. Well, in 1874 the report was exceedingly unfavourable. In 1875 the School Board began a new school, and they appointed a new teacher, and this is the sort of progress which has been made since. In the first year only six out of 134 could be presented in the higher standards. In 1876 the school had an admirable report; in 1879, when the Inspector came, he said, "This is one of the best schools I know; there is no failure in reading and writing, and only two out of 116 failed in arithmetic, and when I visited the place some years ago the education of the children was in a lamentable state. Thanks to the wise policy of the Board and the ability of the teacher, it is now the best school in Argyll." Out of 134, only seven failed, and the Inspector said it was in all respects a model school. I think that a school and School Board making such marvellous progress as that shows, ought to be brought under the notice of the House. Now, Sir, I have given the statistics of England and Wales as to the number who have passed the upper standards. The grants earned in 1879-80 had risen from 15s. 3½d. to 15s. 7¾d., an increase of 4¼d., and the voluntary schools to 15s. 5d., an increase of 1¾d. I said that this is the first time that the Board schools show an advantage over the voluntary schools, but the grant is not always the measure of success, and I say this irrespective of this circumstance in reference to Board schools and voluntary schools. It depends upon the number of infants in the respective schools on the list, for the infants bring down the average, and the real test is the children in the upper standards and the upper ages. Now the average cost in the London School Board schools was £2 17s. 7¾d. per head, and in the voluntary schools £2 0s. 10¼d. The Board schools in the provinces are only £1 17s. 5¾d. I am bound to say that the heavy cost of the London Board schools raises the average of the Board schools throughout the country. The London Board school average was £2 17s. 7¾d., and the London voluntary school £2 0s. 10¼d., against £1 14s. 2d. in the country. I am not going to be the apologist for the London School Board; there is no need for me to take up the defence of the London School Board, as it possesses able representatives in this House. I am bound to say that I was very much struck with that, and I made it my business to institute inquiries as to the cost of the London Board schools as compared with other schools. Now it is only fair, whatever may be said in favour of voluntary schools or Board schools, that it should be fairly and honestly stated. I find that the London Board schools are increasing at the rate of 23,000 a year for the last ten years; that for every year they have to furnish schools and charge that upon the current year's account. Then again, unlike any other Board schools in the country, they have to bear the expense without the grant for this 23,000; so that really, to take the proper average, we believe that it would be impossible to get the cost of the London Board schools until the London Board schools have supplied all this deficiency of education and the children are in average attendance. Then the grant for salaries is very considerable. Then, taking the average of the country schools, no allowance is made in the salaries, but a residence is provided for the masters, whereas in London the residence of the masters is to be paid out of their salaries. That is only fair to be borne in mind; but to show the vast work which the London School Board has yet to do—for it is a vast work, for the deficiency is not nearly supplied, and the new census has shown us that Lambeth alone has increased nearly a quarter of a million during the last ten years—there is the population of one of our great towns, and the London School Board have to keep up with the growth of the population, and this growth represents something like 1,100 persons a week, and in order to make provision for the population they must open one school a month. That is the only way in which the population of London can be provided for. The only wonder is that, looking at the vast work already done, and yet remains to be done, how we could have remained content with such a state of things as must have existed. The total expenditure on education for last year amounts to £5,078,259; to this sum the endowment has contributed £143,000, the voluntary contributions about £731,000; the rates £726,000. Though it is fair to notice that the contributions are still in excess of the rates, it is a most creditable feature. The children's pence contributed £1,431,000, and the Government grant £1,982,000, and the receipts from other sources were £55,000. I am bound to quote these figures to consider what would be the grant, and what must be the rate to make up the enormous deficiencies which would result from these two sources—the Exchequer and the ratepayers. I have now stated everything which relates to the educational work of the past year, and I hope that the House will be satisfied that we are really making progress. I may say that the highest grant, taking the schools in their denominations, was made by the Wesleyan schools. There are one or two points with respect to the working of the Act that I should like to say a few words upon. I believe that those great results which I have been able to lay before the House, and which I hope will be still greater, have been the result of compulsion; without it we could never have achieved such results. I am sorry to say that there are still serious obstacles to the future working of that Act. Only this day I had a letter from a School Attendance Committee that less than half the children in the district were not in attendance, and the reason of only half the children being at school was that when the cases were brought before the magistrates the magistrates had resolved not to convict, and these people set the law at defiance. In many instances—and this was most surprising in London—the magistrates seem to think that they were almost above the law, and they do absolutely set the law at defiance in hundreds of cases. It is remarkable when we consider with what general assent both Houses of Parliament passed the Act last year. Both Houses of the Legislature had allowed the Act to make compulsion general throughout the land to pass without the slightest sign of amendment or opposition, and I think it was a very good omen, and it showed the general assent of the Legislature to the compulsory working of the Education Acts. At the time of passing the Act there were about 16¼ millions in England and Wales under the bye-laws, and by the 1st January it was required that every union and every local authority should make an application for bye-laws. I am glad to report that on the 31st December last the whole of the unions and local authorities throughout England and Wales, except a small remnant numbering only about 260,000 inhabitants, had applied for bye-laws, and now there was no district throughout the land where those bye-laws have not come fairly into operation. But still there are some things that must be amended if the compulsory system is to be efficiently worked. One is the cost and difficulty of proceeding under the Summary Jurisdiction Act. The cost to the locality of taking out summonses and the difficulties which have been unexpectedly imposed have raised very serious obstacles to the working of compulsory education. I do think that parents who are so neglectful of their duty as those who will not take the trouble to send their children to school, and worse still, those who have come under the operation

of the Industrial Schools Act, should be punished. There were cases recently where the man has neglected his own family and allowed them to run in the streets till they were sent to an Industrial School, and was at the same time getting good wages and keeping another family, and not contributing a farthing. They set the law at defiance, because they had no goods to destrain upon. I do trust that something will be done in order to overcome this difficulty. A great deal has been said about taking out summonses. I am bound so say, from the cases which have come under my notice in the Education Department, that the School Boards make very few mistakes. I have had particulars furnished me of the amount of summonses taken out by the London School Board with a view to enforcing compulsory attendance. There is a periodical published which makes it a subject of censure, and says that the London School Board is very harsh with parents. Under the bye-laws, the well-known 'B' notice, where the parents are admonished for not sending their children to school, there were 79,715 notices sent out last year, and out of that number only 7,722 were summoned, and the number of cases dismissed was only 4. Under section 11—that is, to meet the case of habitual neglect—there were 3,871 summonses, and the cases dismissed were only 11. The employers summoned were 22, and only one case was dismissed. I think that is a fair illustration of the working of compulsion, and this disproves the constant allegations of the hardships undergone by parents at the hands of the School Boards. We are asked what are the moral results of the education on which the country is spending five millions a year. We hear a good deal of declamation against our present system as being irreligious. I am quite sure that neither the noble lords opposite (Sandon and Hamilton), who have presided in the Department, will say that they are irreligious. I know in the town of Liverpool, which the noble lord (Sandon) represents, that both the School Board and the voluntary schools work heartily together, and prizes are given in religious instruction in that town, and the results have astonished some of the opponents of the School Boards when they come to see the answers of the children. The same thing was told him in Manchester of the papers submitted to the School Board, and one who is well known for his opposition to School Boards admits he was taken quite aback by the examination papers, and had no conception of the amount of Biblical knowledge which had been attained by the children in School Board schools. If I wanted to disprove the statement about the decline of religious teaching, I could bring a few facts to the notice of the House. The total number of children in voluntary schools in 1870 was 1,449,000, the total in 1880 was 2,759,000, showing that the numbers receiving very distinct religious instruction in voluntary schools had increased by 811,000 children. Of these, there was an increase in the church schools of 627,000; in the Roman Catholic schools of 79,000; in the British and Wesleyan schools of 127,000; and in the Board schools of 1,085,000, showing a total of 1,900,000, or a total increase of nearly 2,000,000. This total increase of nearly 2,000,000 of children in the schools of the country, and a very large proportion in voluntary schools of the country are, except a small number, receiving religious teaching. Then in Scotland the School Boards adhere to the old system. After that statement who can say that there is no religious teaching given to the children? On the contrary, I think that there never was so much religious teaching given to the children of the country as at this moment, and that it was never so well taught and so well understood as since the Act of 1870 was passed. As to the moral results of the Act, we have abundant evidence of them. I have heard from the Chief Inspector of London Police the wonderful change that he believes to be brought about by the vast number of wretched children taken from the streets. In the town of Birmingham Major Bond says that the effect has been to get rid of the young ruffians who used to stand at the street corners, and whose coarse language and coarse manners caused a scandal in all our large towns. There was a great diminution in that respect and in juvenile crime, and the same thing was reported from all parts of the country. We have been going on during the last ten years making progress towards civilising and humanising those who have been neglected in the past. I should like to say a few words as to the devotion of hundreds and thousands of noble men and women who have taken part in the cause of education. It is extraordinary, and the noble lord opposite (Lord Sandon) will bear me out that in towns like Liverpool, Manchester, Birmingham, and elsewhere, when they take up this work they become absorbed in it, and they devote their lives and their energies and a great deal of their money to it. The voluntary effort brought into the School Board system has astonished me. In Manchester, Liverpool, Birmingham, and elsewhere, we find men and women who are doing honour to themselves and sacrificing their time and means to the educational interests of the rising generation. Having concluded what I have to say in that respect, I proceed now to that part of the statement which refers more immediately to the papers which I have laid on the table. The House will be aware that a year ago, when I made my annual statement, we were somewhat under the censure of the upper House. The subject had scarcely been a month before the country before resolutions were made in the other branch of the Legislature denouncing the Code as ambitious and entirely uncalled for. My noble friend, the Lord President (Earl Spencer), promised the other House of Parliament, and I promised this in my statement, that during the coming year we would make full inquiry into the operations of the Code, and if we found that it was not for the advantage of education, and not calculated to bring out the best possible results for the expenditure and the devotion given to it, that we would come down to the House and frankly state what was the result of our inquiry, and I have now here fulfilled that pledge. I may say that we have had complaints as to the Code from I think everybody who takes an interest in education. The teachers complain that it gives too little freedom to teaching, that it gives unnecessary clerical labour, and that it does not distinguish between good and bad teaching and good and bad schools. That schools that display no skill get as much as those where the work is thoroughly well done. From that time to this we have been receiving suggestions from all quarters, and obtaining evidence to enable us to arrive at a wise solution. I cannot enter upon this subject without speaking of the great assistance we have received, and the ability and zeal shown by the officials in the permanent branch of my Department. Personally, I cannot but express my obligation for what they have done in this matter, and the way in which they have set themselves to accomplish this reform. I should have been unable to make such a statement, or to have laid it on the table in the shape I now place it, had it not been for the intelligence and ability of the permanent staff with which I have been associated. It is due to them that I should acknowledge the assistance they have rendered in getting out the scheme which I have laid on the table. In the first place, we had memorials from School Boards and from persons connected with education who made suggestions for the improvement of the Code. We found ourselves able to agree upon certain principles, and then papers were prepared by twenty or thirty of our principal Inspectors, and we elicited from them the freest possible criticism, and asked them to give suggestions as to the best system which their long experience enabled them to give. Having received those reports, we were enabled to make a draft report, and we agreed further that the matter should be thoroughly sifted and the detail worked out by a committee. The House would like to know the process by which we arrived at that. Sir Francis Sandford, Mr. Sykes, and Mr. Cumin represented the three chiefs of the Education Department; Mr. Warburton, Mr. Sharpe, and Mr. Fitch, the three Inspectors representing the great training colleges—Mr. Warburton for his experience in smaller schools, and Mr. Sharpe for the larger schools. I presided over this committee myself, and Mr. Hodgson acted as secretary, and we had many a long and laborious day's work in arriving at the scheme which we have now submitted to the House. When we had accomplished that, we felt that we must put our work through a finer sieve and must call in additional critics, and we added to the committee Mr. Matthew Arnold, Mr. Moncrieff, Mr. Oakeley, and Mr. Blakiston, and Lord Spencer himself presided over that committee, and the result is

that which I have laid on the table. I must say in laying it upon the table of the House that I do so with great hope and great confidence. But we do not ask, and we shall not ask the House to assent to it as it stands. We simply submit it as the proposals to form the basis of the future Education Code of the country. We ask that it shall receive, not only the fullest criticism, but we hope that it will receive fair consideration. It is not to be made a party question. But we must all assist in the good work. It is not a party question with us. We will take good care that we deal with all schools on an equality—treating them all alike, whether voluntary or Board Schools; and they will come under the same regulations and receive the same grant if they have the same capacity. What we wish to arrive at is sound educational principles, and if we arrive at sound educational principles we can deal with the money payment afterwards. We do not want to go into the question of whether we pay 3d. too much for this or 6d. too much for the other; but what we want to know is what will present the best results and the most thoroughly sound education. I can only say that I trust that during the recess I shall receive suggestions from all parts of the House, and I can promise on behalf of the Department that they shall receive our candid and careful attention. Now I shall submit a few heads of the scheme. Under the first head we deal with the attendance. It is proposed to adopt the average attendance in each school as the basis of the grants which have hitherto been made on account of individual scholars, whether infants under seven years of age presented to H.M. Inspectors for collective examination or children above seven presented for examination in reading, writing, and arithmetic. The next is that '250 attendances will be no longer required as a condition of examination, but all scholars who have been on the register for six months will, unless there is a reasonable excuse for their absence, have to be presented to the Inspector.' Now with reference to that, I have to say that this is the fairest measure of the work of the school. The grant now depends too much upon chance circumstances and accident over which teachers and managers have no control. For instance, a wet day for inspection, or a snowy day, or the absence of some of the principal children, immediately affects the grant, and the school suffers for one year in consequence of these circumstances. Another reason is that it will keep the work of the school equal. The failure in any part will affect the whole school; and it will tend to make the teachers take an interest in the good and bad scholars alike, and will lead them to take as much interest in the proficient and non-proficient, and in the quick and the dull scholars. The change is in the interest of the children generally. There are constantly cases coming before me of loss to teachers from the causes I have indicated. There was an event which came before me the other day, of a loss arising from the removal of a battery of artillery. These are hardships which are constantly arising; but there is something more serious. We shall remove the temptation to tremendous fraud. It was the most painful part of my duty to have to sit in judgment on teachers who had been tempted to make one or two strokes of the pen which had brought them under the charge of fraud, and the inevitable consequences following, that their certificates are suspended and their characters blasted, and their careers blighted or ruined. I had a case on Saturday last where it only required one single stroke of the pen to complete the number of attendances of one boy. He attended 249 times, and the schoolmaster made that one stroke. What was the difference in that school? That single stroke made £16 difference to that school, because it just brought that boy into the list of boys to be presented. It brought them within the 20 per cent., and it made just £16 difference. We have had cases where two strokes have made £10 and £20, and even £30 and £40 difference to the school; and when the master has done all he can, and the boys fail him at the last moment, I must say that the temptation is very strong to bring up the attendance of the school, and I think that temptation ought to be removed. Abolishing those 250 attendances will remove the strain on the teacher's mind; and it will be the fairest way to obtain payment by results, and I am quite satisfied that it will give great elasticity of teaching and improve the whole system. Now we say under the third clause that grants will be so assessed that the present average rate of aid will, as far as possible, be maintained. The fair school will receive nearly the same grant, the bad school will receive a little less, and the good school a little more; and thus we discriminate between the various schools. Then there will be grants common to all schools. As to music, we propose that the full grant will be paid if the singing is satisfactorily taught from notes, or according to the Tonic Sol-fa system. Only one-half will be paid if the singing is taught by ear. Then there is a sewing schedule which we felt we might make a little lighter for the younger scholars. We felt that it was too much for the younger scholars, and the fancy sewing was not exactly what we wanted. Clause six is also common to all schools; and this is called the Special Merit Clause. This is a clause which will do more, perhaps, to lift the tide of education than any other in the scheme. 'The Inspector shall have regard to (*a*) the organisation and discipline; (*b*) the employment of intelligent methods of instruction; and (*c*) the general quality of the work in each school, especially in the standard examination; and shall have power to recommend an additional grant on the average attendance, varying in amount according as the school is, in these respects, fair, good, or excellent.' There will be a special merit grant on these three heads. Now, I think the House will say: 'You are placing great powers in the hands of the Inspectors.' Well, I will show how that is proposed to be done when we complete the organisation for inspection, and by it we hope to ensure greater economy, and greater efficiency, and much greater uniformity than hitherto. I now come to infant schools; these also have an average attendance, and where the infants in a school amount to forty, a separate adult teacher will be required for their instruction. For more than sixty infants a certificated teacher will be required. We cannot have infants committed to the charge of monitors or young pupil teachers. We must insist upon better infant school teaching—the foundation of all teaching—and we propose also that part of the grants will be made to depend upon the infants being taught by special methods, something akin to the Kindergarten, giving appropriate and varied occupations; suitable instruction in the rudiments of reading, writing, and arithemetic; and a systematic course of simple lessons on objects (and we want that carried right through the school), and on the phenomena of nature and of common life. Then infants between six and seven may at the discretion of the Inspector be examined individually according to Standard I. of the Code of 1870; and if any scholars in an infant school are taught in Standard I. they will be examined and paid for as in schools for older children. Then we come to boys' and girls' schools. Payments on the passes of individual scholars will be abolished, and 250 attendances will be no longer required as a condition of examination. Then we stipulate that 'all scholars on the register shall be present at the inspection unless there is a reasonable excuse for absence; and all such children who have been six months and upwards on the registers are to be presented for examination.' Then as to the mode of assessing the grant. 'The grant will be calculated on the results of the examination of these scholars. It will be based upon the proportion of passes actually made to those that might have been made by the scholars examined.' I cannot claim credit for this invention; it is one of the simplest, and it saves an immense amount of labour. Let me explain it. It states the proportion of passes actually made to those that might have been made. Now, supposing you had 100 children, the maximum they might make would be 300 passes; supposing they make 270 passes, that is ninety per cent., and supposing they make 240 passes, that is eighty per cent., they will be paid for thus:—10s. when they make 100 passes per cent., then 9s., and 8s. when they made ninety and eighty passes per cent. But the House will see that there will be no longer that temptation to push forward children who can make a certain percentage; it will be based upon the work of the school and upon the special merits of the school, and I believe in that respect we may expect a vast improvement and get better results out of the teaching. In Standards I. and II. we propose, unless either of them is a standard for half-time labour, that instead of examining every child—and there are three or four milions of children scheduled

in the Education Department—instead of examining them individually, the Inspectors will examine such a number of scholars as will enable them to estimate the quality of the instruction in each of the three elementary subjects. The Inspector may take ten, twenty, or thirty children just as he pleases. When you get to Standard III., where the passes are important, and where the parents like to know how their children are getting on, then for the present at least all scholars presented in Standard III. and upwards will be examined. More than one million and a quarter of the children are examined in Standards I. and II., and the examination of those little children under seven years of age in the very simplest elements imposes upon the Inspectors an amount of labour perfectly unnecessary, and this amount of drudgery we propose to relieve the Inspectors of. Well, then, we propose to add a Seventh Standard. We had six standards, but what was the result? In many a rural school, when a boy has passed the Sixth Standard, and wants to stay a little longer, the teachers are anxious to get rid of him. I have complaints saying, 'My boy has passed the Sixth Standard, and I want to keep him at school, and they say that they cannot keep him unless they double his fee, because he does not earn a grant.' We believe now that we must have seven standards. We say that if any scholar, over ten years of age, is, after the 1st April, 1883, presented in the First or Second Standard, the passes made by such scholar will not be reckoned in calculating the percentage of passes for the purpose of a grant. Then I come to a very difficult question—the question of class subjects. I have satisfied myself that specific subjects in the Fourth Standard lead almost entirely to cram. They are simply used for the purpose of getting a grant, and we have little physiologists and little geologists of nine or ten years of age who get up some technical words which they do not understand, and that has done very much to the neglect of thoroughness in other subjects. Now there are some things that children should know, some common facts that children ought to be made acquainted with. I want the House to bear in mind we have to work and take the condition of the labour market into consideration, and the state of the Acts, and the fact that the majority of our passes are in the Fourth Standard, and the children who pass the Fourth Standard we want to learn something more. There are some things that they ought to learn, and they ought to have some standard work, and acquire a knowledge of certain specific subjects in addition. I think it is better to remove the specific subjects to the Fifth Standard. The school will be regarded as made up of two divisions—in the lower division, Standards I. to IV.; and in the upper, Standard V. and upwards. Two class subjects may be taken in each division. English will be taken as a class subject—that is to say, grammar and recitation. A boy ought to know something of his own language and something of the poetry and literature of his own language, and we insist that it shall not be the commonplace stuff that is to be found in the school-books; but we propose that they shall learn good English, and get them to learn a hundred lines of Milton or a hundred lines of Shakespeare; and instead of taking a fourth or fifth-rate obscure poet, we intend them to read Milton and Shakespeare in the Fifth, Sixth, and Seventh Standards. We say that geography, including physical geography—in fact, the two subjects must be taught together. Mr. Fearon, who represents the physical geography, has a proposition. He proposes that in the First Standard they shall know the meaning and use of the map. A plan of the school and the playground will be given, and he desires that they shall know the four cardinal points. Then they shall go on to the size and shape of the world, geographical terms will be explained and illustrated by reference to the map of England, and physical geography with reference to rivers, and so on. What they do learn they shall learn not merely from books. My learned friend the member for the University of Dublin said that he never meant that they should be taught merely from reading-books, but that they should have illustrations. We propose that they shall have illustrations. Then we pass on to what we call elementary science. English (grammar and recitation), geography (including physical geography) and elementary science, will alone be recognised as class subjects in the lower division, and if only one class subject is taken in the lower division it shall be English; if two are taken the second shall be geography or elementary science. The upper division may take as class subjects any of the three subjects to which the lower division is restricted, or history, or a specific subject, treated and examined in as a class subject. The grant for class subjects will be made, as now, on the average attendance, and an increased grant will be paid if 20 per cent. of the scholars examined are presented in Standard IV. and upwards. We propose that one of the reading-books in each standard must be an historical reading-book, adapted to the ages of the scholars in the standard. Now I do not know why children who read something should not have historical reading-books, so that a child may know something of the history of his own country. Then there are specific subjects. We say that no scholars shall be examined in specific subjects if the percentage of actual to possible passes in the elementary subjects of the previous inspection was less than 75—that is, unless 75 per cent. of them pass in standards; we say that they shall not take up specific subjects until they have done this. I now pass on to the night schools. They are thoroughly on the decrease. Their decline is something like from 70,000 or 80,000 to 40,000 in this year. The teaching of merely the three R's in the night school has ceased to be attractive. Children are taught them in the day school, and then the condition of boys who have been presented in a higher standard in the day school has gone a long way to ruin the night schools, and I think our night schools may be said to be in a most miserably declining condition. Now we propose to do this. We are anxious that a boy whose short school life in the Fourth Standard ended at ten or eleven years of age may have some chance of carrying on his education during the evening. We do not propose to make his attendance compulsory; a boy who has worked eight or ten hours cannot be compelled, he must be attracted. We have laid down three simple clauses for the night schools. 'Grants will be no longer confined to reading, writing, and arithmetic, but will be made also for proficiency in class subjects.' As something more than reading and writing will be taught hereafter in the night schools, grants will be paid in respect of those children only who, having passed the standard fixed by the bye-laws of their district for total exemption, are under no obligation to attend school and are not day scholars. That is to say, a boy who has passed his full time standard, and leaves the day school before he can receive the grant, may attend a night school. There is another clause which I hope the House will agree to—it is that a teacher in a night school need not be a layman. I know that the Nonconformist ministers may help the teachers of the night schools, whose burden is heavy enough. Often in the rural districts the only intelligent person who can assist the schoolmaster might be the Nonconformist minister, and I ask that he shall be allowed to assist the schoolmaster. At present we allow none but laymen to teach in the day schools, and I see no reason why a Christian brother, or a local preacher, should not assist at a night school. I see no reason why a clergyman who wishes to be useful cannot be allowed to assist in a night school. But if there is any blame or any merit due to that suggestion it is due to me. I am prepared to take the full share of discredit, if any, for that suggestion. I know from my experience in my earlier youth that all the knowledge of natural history I obtained was at a night school taught by a clergyman, who at the same time taught a friend of mine, now one of the greatest naturalists living, and the secretary of the Royal Geographical Society—Dr. Bates. At the last meeting of the British Association at Sheffield, there were several clergymen who desired to teach botany to children, and those men found that they were excluded from the schools, and they had to take the children to their own houses to give them lessons. I think that the House will not misinterpret my desire to utilise all those forces. Special grants to pupil teachers will be continued. Not more than three pupil teachers will be allowed in any school or department, whatever number of certificated teachers may be employed. The number of pupil teachers to be employed as teachers are now in excess considerably, and there will be some 76,000 school teachers without hope

of employment when they have finished their apprenticeship. We also abolish the stipendiary monitors. They have not been a success. Candidates for apprenticeship as pupil teachers will be required to pass Standards V. and VI. Then, as to the staff in the school, an assistant teacher will count as sufficient for sixty scholars instead of eighty, as heretofore; and no teacher examined at or after Christmas, 1882, will be allowed to have pupil teachers who has not passed in papers of the second year. We wish to raise the *status* and qualification of the teacher. We are closing a side-door by which incompetent persons enter the profession, and I shall tell you how we intend to open another door. By clause 38 we make a fair and right concession to the schoolmaster. The annual entries made by inspectors on teachers' certificates will be discontinued after they have been raised to the first class. We often have complaints that a young inspector will endorse the certificate of an old teacher in a way very disheartening to the teacher in his work. If a man has once attained his first class, he can always get from the Department a record of his services, and he will be entitled to claim from the managers of his school a certified copy of the inspector's yearly report when it is entered in the log book. We propose to open another avenue to the teaching profession. In my experience in the Education Department I have applications by the dozen—almost by the hundred—from university men who want some occupation. We are multiplying very largely the number of men who attend the university. All our grammar schools have scholarships. That bridges the gulf between elementary schools and the universities. In the town of Birmingham the system is so complete that you have a perfect network of elementary schools. Then you have the higher schools for those who have to pass out in the fourteenth or fifteenth year; and, further, you have your middle-class scholarships founded by King Edward's foundation. The same thing takes place in Manchester, Liverpool, and Nottingham, and if we can only get the endowments of the country applicable to their proper objects, if we can only get the endowments dealt with with any degree of rapidity, we shall have a complete system of middle-class education which will meet the wants of, and give a stimulus to, the elementary schools. This brings, moreover, more men to the universities. A man going to the university in Scotland carried his university teaching into business; but in England a man who had been at the university thought he must be a professional man, or a servant of the Government, or have some employment that is not in the ordinary line of common employment. We propose to open the doors to those who come from the university, and to make them teachers. We say that graduates of any university in the United Kingdom, and women who have passed certain of the higher examinations held by the universities, may be recognised as assistant teachers, and will be admissible to examination for certificates after serving as assistants for one year in a school under inspection, if the inspector reports favourably of their skill in teaching and reading, and in the case of women, of needlework. We require them to come to work for a year, and offer them a fair field, and it will be a field through which they will pass to the schools. It will bring up the whole profession, and raise the tone of the teachers of the elementary schools by the qualifications which these teachers will possess. I am now about to conclude. Certificates will be no longer granted without examination; and no certificate will be cancelled, suspended, or reduced until the Department has informed the teacher of the charges against him, and has given him an opportunity of explanation. Now I have two questions about which my noble friend, Lord Sandon, has some difficulty, and as to which I know that whatever merit there is in them is due to my noble friend; but I believe they were made to meet a state of things that is now passing away. The payment of honour certificates will be discontinued. The noble lord thought the honour system stimulated the attendance of children, and that it was one of the means of indirect compulsion. He expected that it would be largely availed of, and it was thought there would be a payment of £50,000 a year; instead of which, owing to the objection that it was always to be a reward in the future, and that it was prospective and not retrospective, the honour certificate has caused a great deal of heartburning and a great deal of difficulty, and I know of nothing that has caused so much trouble to the Department. A person feels that the child at the end of the year, if he does not receive his payment back, is in some little difficulty, and that it is a wrong done to the children. Now there is no need of this stimulus any longer, and I think it can be better employed in bringing them into the night school than in spending £50,000 a year, which goes mainly to the children of the lower middle-class. Then there is another question: The production of a child's school-book will no longer be required as a condition of the payment of annual grants. Now the school-book was meant to keep a record of the age and attainments of the child, so that it might be a record for all purposes, whether as a record for labour, or on passing from school to school. I was very sanguine myself, and I know I spoke very strongly on this, and I am bound to say that nearly all over the country it is a complete failure. In a town like Birmingham not 2 per cent. of the school-books have been used. Some of the children have three and four, and as many as eleven school-books, and I find a statement here where a child has been found with three school-books with a different age in each school-book, that each of the ages was a wrong one, and the factory inspectors refused to accept the school-book as the real proof of the child's age. Therefore the child's school-book must go, and we no longer make the production of the school-book necessary. I am almost ashamed to look at the clock. I have only one more topic to speak upon, and I have no doubt I will be asked what are we going to do with the system of inspection, for if we are going to give special money grants to schools, how are you going to deal with individual inspectors who make grants on mere caprice? Well now, our system of inspection is somewhat overgrown. The whole Department has grown up so rapidly, and inspection of every individual student has been considered so important, that we have a large number of inspectors—120 or 130—and an equal number of inspectors' assistants, and if we continue to examine them we must increase this staff every year. We have complaints from various parts of the country as to the laxity in some cases and the want of indulgence in others, and these complaints cause a great deal of trouble and anxiety. What we propose to do is to divide England and Wales into districts. We shall take from amongst our very best and most trusted inspectors a certain number of men to be inspectors of those districts, and we shall place them at the head of those districts. Under those inspectors there will be other inspectors, who will be subordinate in the district, and with that inspector they will have to communicate, and he will be held responsible for their work. We propose by that to diminish the higher grade of inspectors, and to call into existence another class of inspectors. We have no freedom. Some of our ablest and best inspectors' assistants, who have taken university degrees, men of high character and ability, who have spent a dozen years in the service of the Department, cannot earn any considerable addition to their salary, and, after doing good service, perhaps only receive £175 per annum. We propose to get an inspector between the inspector and the inspector's assistant, and we propose to have sub-inspectors recruited from the ranks of the inspectors' assistants and from the ranks of the schoolmasters. The salaries of those sub-inspectors would have to be fixed by the Treasury, but they would only be called into existence as sort of supernumeraries when others retire or drop off; but we propose that the chief inspectors of the Department—and there are twelve or fifteen of them—shall once a year meet at Whitehall, and lay down a regular system of examination for their respective districts. They shall agree upon a plan and upon their tests as to good, fair, and excellent, and shall then enforce that uniformity upon the inspectors below them. We hope by this means to achieve much more uniformity throughout the country. I do not intend that any inspector shall be employed who has not had ample preparation and experience in the schools, but we do intend that there shall be some test exacted from inspectors as to their capacity to inspect, and as to their ability to descend to child-life. I must apologise to the House; and although my statement must be rather dry, I feel that the Department with which I am connected is as much associated with the honour and the greatness of England as our army and navy.

Pupil Teacher's Examination Questions.

JULY, 1881.

CANDIDATES.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. Find the cost of 15,378 articles at 16s. 7¾d. each.
2. 13¼ tons at £3 17s. 10½d. per cwt.
3. How many lbs. of coffee at 2s. 3d. per lb. are equal in value to 255 lbs. of tea at 4s. 9¾d. per lb.?
4. If 1 cwt. of sugar costs £2 16s. 6d., what will 1 ton 17 cwt. 1 qr. cost?

FEMALES.

1. Make out the following bill:—

189 yds. of cloth at 15s. 6d. per yard.
14½ ,, diaper at 1s. 7d. ,,
64 ,, muslin at 12s. 6d. ,,
72 ,, cambric at 5s. 6d. ,,
14 hats at 12s. 6d. each.
19 umbrellas at 18s. 7½d. each.

2. What will be the cost of 14,865 articles at 13s. 6½d.?
3. Find the value of 16 yds. 2 ft. 10 in. at 2s. 6½d. per yard.
4. Find the cost of 70,014⅜ articles at £1 13s. 8d. each.

Grammar.

1. 'The building rook will caw from the windy tall elm-tree,
And the tufted plover pipe along the fallow lea,
And the swallow will come back again with summer, o'er the wave;
But I shall be alone, mother, within the mouldering grave.'

(*a*) Point out and parse the verbs and adjectives in the above.

2. How many kinds of adjectives are there? Give two examples of each.
3. What is the difference between adjectives and adverbs?

Geography.

1. What names are given in the British Islands to points of land projecting into the sea? Give examples of the use of each term, and *(if you can)* draw little sketch maps as illustrations.
2. Describe as fully as you can the position of the chief heights in the *Cumbrian group*, and the lakes connected with them.
3. What are the chief objects of interest which a visitor to Ireland ought to see? Give the position of each, and describe *one* of them fully.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Elementary*.

Write, in small hand, as a specimen of copy-setting, '*Example and practice are more efficient than precept and theory.*'

Write the following passage from Dictation.

The sun was going down | in a clear sky; | and when, | turning from the dazzling western sea, | the eye wandered eastwards, | the view was such | as could not but transport | a heart at ease. | The tide was low, | and long shadows | from the rocks | lay upon the yellow sands, | and darkened, | near the shore, | the translucent sea. | At the entrance of the black caverns, | the spray leaped up | on the advance of every wave, | not threatening, | but as if at play. | Far away | over the lilac and green waters | rose craggy peaks, | whose projections and hollows | lay in the softest light and shadow.

CANDIDATES.—ANSWERS.

Arithmetic.

MALES.

1.

	£	s.	d.	
	15378	0	0	= value at £1 0s. 0d.
3s. 4d. = ⅙ of £1	2563	0	0	= ,, 3s. 4d.
¼d. = 1/160 of 3s. 4d.	16	0	4½	= ,, ¼d.
	2579	0	4½	= ,, 3s. 4¼d.

∴ the value of 15378 at 16s. 7¾d. = 12798 19 7½ Ans.

2. 13¼ tons = 265 cwt.

(*a*) 265 cwt. at £4 = £1060 0s. 0d.

(*b*) 265 ,, 2s. = £26 10s. 0d.
265 ,, 1½d. = £1 13s. 1½d. — £28 3s. 1½d.

265 cwts. at £3 17s. 10½d. = £1031 16s. 10½d. Ans.

3. 2s. 3d. : 4s. 9¾d. :: 255 lbs. :

$255 \text{ lbs.} \times \frac{231}{108} = \frac{85 \times 77}{12} \text{ lbs.} = 545\frac{5}{12} \text{ lbs.}$ Ans.

4. 1 ton 17 cwt. 1 qr. = 37¼ cwt.

	£	s.	d.		£	s.	d.
	37	5	0				
			2				
	74	10	0	= value of 37¼ cwt. at	2	0	0
10s. = £¼	18	12	6	= ,, ,,		10	0
5s. = ½ of 10s.	9	6	3	= ,, ,,		5	0
1s. 3d. = ¼ of 5s.	2	6	6¾	= ,, ,,		1	3
3d. = ⅕ of 1s. 3d.		9	3¾	= ,, ,,			3
	105	4	7½	= ,, ,,	2	16	6

FEMALES.

1.

			£	s.	d.
189 yds.	at 15s. 6d. per yd.	=	146	9	6
14½ ,,	,, 1s. 7d. ,,	=	1	2	11½
64 ,,	,, 12s. 6d. ,,	=	40	0	0
72 ,,	,, 5s. 6d. ,,	=	19	16	0
14 hats	,, 12s. 6d. each	=	8	15	0
19 umbrellas	,, 18s. 7½d. ,,	=	17	13	10½
	Total	=	233	17	4 Ans.

2.

	£	s.	d.		s.	d.
	14865	0	0			
10s. = £½	7432	10	0	= value of 14865 at	10	0
3s. 4d. = ⅓ of 10s.	2477	10	0	= ,, ,, ,,	3	4
2½d. = 1/16 of 3s. 4d.	154	16	10½	= ,, ,, ,,		2½
	10064	16	10½		13	6½

3.

	£	s.	d.	
	0	2	6½	
			17	
	2	3	2½	value of 17 yds.
2 in. = 1/18 of 1 yd.			1 25/36	,, 2 in.
	2	3	0 29/36	,, 16 yds. 2 ft. 10 in. Ans.

4.

	£	s.	d.		£	s.	d.
	70014	7	6	= value of 70014⅜ at	1	0	0
10s. 0d. = £½	35007	3	9	= ,, ,,		10	0
3s. 4d. = ⅓ of 10s.	11669	1	3	= ,, ,,		3	4
4d. = 1/10 of 3s. 4d.	1166	18	1½	= ,, ,,			4
	117857	10	7½	= ,, ,,	1	13	8

Grammar.

1. *building*—verbal adj., qual. *rook*.
will caw—intrans. reg. verb, indic. mood, fut. indef. tense, 3rd pers. sing., agree with *rook*.
windy—adj., qual. *tree*.
tall—adj., qual. *tree*.
tufted—distinguishing adj., qual. *plover*.
(*will*) *pipe*—intrans. reg. verb, indic. mood, fut. indef. tense, 3rd pers. sing., agree. with *plover*.
fallow—adj., qual. *lea*.
will come—intrans. irreg. verb, *come, came, come*; indic. mood, fut. indef. tense, 3rd pers. sing., agree with *swallow*.
shall be—subst. verb, *am, was, been*, indic. mood, fut. indef. tense, 1st pers. sing., agree. with *I*.
alone—predicative adj., qual. *I*.
mouldering—verbal adj., qual. *grave*.

2. The kinds of adjectives are—1. *Qualifying*, as, *virtuous*, *beautiful*. 2. *Quantifying*, as, *one*, *thirty*. 3. *Demonstrative*, as, *this*, *yon*.

3. *Things* belonging to the same group are distinguished from each other by certain qualities or attributes, which are denoted by *adjectives*. In like manner, different instances of an action or attribute are distinguished from each other as regards *time*, *place*, *manner*, *degree*, by the *adverb*.

Geography.

1. The names given to projecting points of land in Great Britain and Ireland are :—

Cape—Cape Wrath, north-western extremity of Caithness, a lofty pyramidal rock.
Head—Duncansby Head, north-eastern extremity of Caithness.
Mull—Mull of Cantire, south of Argyleshire, a narrow peninsula 50 miles long.
Ness—Buchan Ness, in Aberdeenshire, a rocky headland 33 feet above the sea.
Point—Ardnamurchan Point, most westerly part of the mainland of Britain, the end of a long tongue of land.
Butt—Butt of Lewis, a tapering point, the extremity of the island.
Foreland—North and South Foreland, the termination of the Downs.
End—Land's End, an abrupt mass of granite rock in the south-west of Cornwall.
Bill—Portland Bill, south of Dorset, a long spur of rocks striking out westwards.
Ord—Ord of Caithness, rises on the east of the county from the shore with a sharp ascent of 700 feet.
Peculiar { *Naze*—The Naze, in the east of Essex.
Needles—The Needles, eastern point of the Isle of Wight. }

2. The centre of the Cumbrian group is marked by ***Helvellyn***, 3,000 ft. high; the northern borders by *Skiddaw*, the great western heights by *Scafell*, the loftiest mountain in England, 3,162 ft., and by *Bowfell*, lying near it. To the south is *Coniston Old Man*, whence the hills gradually fall to the sea in the peninsula of Furness.

The chief peculiarity of the English lakes is that those of any consequence lie embosomed in the narrow valleys which are ranged round Helvellyn, the centre of the Cumbrian Group, and radiate outwards in all directions. The largest are *Windermere*, *Haweswater*, *Ulleswater*, *Thirlemere*, *Derwentwater*, *Bassenthwaite Water*, *Buttermere*, *Crummock Water*, *Enneraale Water*, *Wastwater*, and *Coniston Water*.

3. The chief objects of interest to one visiting Ireland are—***Connemara***, a peninsula in the W. of Galway, ***Lough Neagh***, and the ***round tower*** of Antrim—the round towers of Ireland have long puzzled antiquarians; ***Giant's Causeway***, near Bengore Hd., in N. of Antrim, consisting of 40,000 basaltic columns stretching into the sea; ***Bog of Allen*** (250,000 acres of morass), occupying Kildare, King's Co., Meath, and Roscommon; ***St. Patrick's Purgatory***, a place sacred to R. C.'s, in L. Derg, in Donegal; ***Lakes of Killarney***, consisting of an Upper, a Middle, and a Lower Lake, with magnificent scenery; ***Lake of Serpents***, in the vale of Glendalough, amid the Mts. of Wicklow; ***Curragh*** of Kildare; ***Castle Blarney***, near Cork; the Marble Quarries of Kilkenny, etc.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. If $2\frac{1}{4}$ cwt. cost £$46\frac{1}{5}$, what is the cost of $13\frac{1}{8}$ lbs.?
2. Reduce $\frac{5}{7}$ of 17s. $3\frac{1}{4}$d. to the decimal of £1, 3s. $1\frac{1}{2}$d.
3. Find the value of $2\cdot8680\dot{5}$ of 3s. 0d., + $\cdot8\dot{3}$ of 4s. 0d. + 1·8 of 5s. 0d., and subtract the sum of the whole from one guinea.
4. Add $\frac{10}{13}$ of 1s. 6d. to $\frac{73}{300}$ of $\left\{\frac{\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{7}{24}}{2}\right\}$ of £1, and subtract their sum from $\frac{2}{15}$ of 12s. 6d.

FEMALES.

1. A field of 12 acres having 120 stalks to each square yard, and 70 grains to each stalk, produces wheat to the value of £96, 16s.; what will be the worth of the produce of 800 sq. yds., having 175 stalks to the sq. yd., and 45 grains to each stalk?

2. If I pay 1s. 3d. for 6 lb. 14 oz. of bread, when wheat is 4s. 9d. per bushel; what must I pay for 23 lb. 12 oz. when wheat is 5s. 5d. per bushel?

3. I spend 12 guineas in 35 days, and save £100 a year; what must I earn in the year?

4. An income of £3,827, 12s. 6d. is taxed at the rate of sevenpence in the pound; how much clear income will remain?

Grammar.

1. Parse the pronouns in the following :—

What dwelling shall receive me? In what vale shall be my harbour? Underneath what grove shall I take up my home? and what clear stream shall with its murmur lull me into rest?—WORDSWORTH.

2. How can you prove, in the following examples, that the relative agrees with the antecedent *in person*?

(*a*) 'Thou, O spirit, that dost prefer.'
(*b*) 'I that speak in righteousness.'

3. The following words—*save*, *except*, *but*—are sometimes used as prepositions, sometimes as conjunctions :—How can you tell when they are prepositions? Give examples of their use as such.

Geography.

Answer *either* Q. 1 *or* Q. 3, *not both*.

1. What are the chief objects of interest which a visitor to Ireland ought to see? Give the position of each, and describe *one* of them fully.

2. Draw a map, showing the coast-line of France, from the Pyrenees to the frontier of Belgium, and the courses of the three great rivers which flow into the Bay of Biscay and the English Channel, with their tributaries.

3. Name the seaports of Russia, and describe the advantages and disadvantages of each.

History.

1. Write out a list of our sovereigns from Alfred to Harold II., with dates.

2. Give the names and dates of sovereigns who filled the English throne in the sixteenth century.

3. What sovereigns have reigned in England since 1700? Give their dates.

Penmanship.

Write in large hand, as a specimen of copy-setting, the word *Elementary*.

Write, in small hand, as a specimen of copy-setting, '*Example and practice are more efficient than precept and theory.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. $2\frac{1}{4}$ cwt. : $13\frac{1}{8}$ lbs. :: £$46\frac{1}{5}$: x.

$$£\frac{231}{5} \times \frac{105 \text{ lbs.}}{252 \times 8} = £\frac{77}{8 \times 4} = £2\ 8s.\ 1\tfrac{1}{2}d. \quad \text{Ans.}$$

2. $$\frac{\frac{5}{7} \text{ of } 17s.\ 3\frac{1}{4}d.}{£1\ 3s.\ 1\frac{1}{2}d.} = \frac{\frac{5}{7} \text{ of } 207\frac{1}{4}d.}{277\frac{1}{2}d.} = \frac{5 \times 829}{7 \times 1110} = \frac{829}{1554} =$$

$\cdot5\dot{3}34620\dot{6}$. Ans.

3. $$\begin{aligned} 2\cdot8680\dot{5} \text{ of } 3s. &= 8\cdot60416\dot{6}s. \\ \cdot8\dot{3} \text{ of } 4s. &= 3\cdot3333\dot{3} \\ 1\cdot8 \text{ of } 5s. &= \underline{9\cdot\quad\quad} \\ &\ \underline{20\cdot9375} \end{aligned}$$

21s. − 20·9375s. = ·0625s. = $\frac{3}{4}$d. Ans.

4. (*a*) $\frac{9}{16}$ of 1s. 6d. = $10\frac{1}{8}$d. = 0 s. $10\frac{1}{8}$ d.

(*b*) $\left\{ \frac{\frac{1}{3}+\frac{1}{4}+\frac{1}{8}+\frac{7}{24}}{2} \right\}$ of £1 = $\frac{8+6+3+7}{48}$ of £1 =

$\frac{1}{2}$ of £1; and $\frac{73}{800}$ of 10s. = 0 $9\frac{1}{8}$

Sum of (*a*) and (*b*) = 1 $7\frac{1}{4}$

(*c*) $\frac{2}{15}$ of 12s. 6d. = 1 s. 8 d.

Subtracting 1 $7\frac{1}{4}$

Diff. = 0 $0\frac{3}{4}$ Ans.

FEMALES.

$$\left.\begin{array}{l} \text{58080 sq. yds. : 800 sq. yds.} \\ \text{120 stalks : 175 stalks} \\ \text{70 grains : 45 grains} \end{array}\right\} :: £96\ 16s. : x.$$

$$\frac{1936s. \times 800 \times 175 \times 45}{58080 \times 120 \times 70} = £25. \quad \text{Ans.}$$

2.
$$\left.\begin{array}{l} \text{6 lbs. 14 oz. : 23 lbs. 12 oz.} \\ \text{4s. 9d. : 5s. 5d.} \end{array}\right\} :: 1s.\ 3d. : x.$$

$$\frac{15d. \times 380 \times 65}{110 \times 57} = \frac{650}{11}d. = 59\frac{1}{11}d. = 4s.\ 11\frac{1}{11}d. \quad \text{Ans.}$$

3.
$$\frac{£12\ 12s. \times 365}{35} = £1\ 16s. \times 73 = £131\ 8s.$$

he saves 100 0

∴ total yearly earning = 231 8s.

4. £$3827\frac{5}{8}$ @ 7d. per £.

7

12)$26793\frac{3}{8}$d.

2,0)223,2s. $9\frac{3}{8}$d.

£3827 12s. 6d. − £111 12s. $9\frac{3}{8}$d = £3715 19s. $8\frac{5}{8}$d. Ans.

Grammar.

1. *me*—1st pers. pron. masc. (?) sing. obj. gov. by *shall receive*.
   my—pron. poss. adj., qual. *harbour*.
   I—1st pers. pron. masc. sing. nom. subj. of *take*.
   its—pron. poss. adj. qual. *murmur*.
   me—1st pers. pron. mas. sing. obj. by *lull*.

2. That the relative *that* (a) agrees with its antecedent *thou* is proved by its taking the inflection of the verb (*dost*) required for *thou*, and (b) taking the form *speak*, just as if *I* was standing in place of *that*.

3. *Save*, *except*, and *but*, should be parsed as prepositions when they are followed by a noun or pronoun, which is not the subject of a verb; as, 'All perished save *me*,' ' . . . . . all *but* the nightingale.'

Geography.

1. *See same question answered under Candidates' paper in this number of Magazine.*

3. The seaports of Russia are—*Archangel*, at the mouth of the North Dwina, exports corn, hemp, flax, and timber, but locked by ice for half the year. *St. Petersburg*, on the Neva, with a very extensive foreign trade in tallow, hemp, flax, etc. Owing to the shallowness of the Gulf of Finland most vessels unload at *Cronstadt*, a great fortress and naval port. *Riga*, the third port in Russia, exports the usual Russian products, but the Gulf is much impeded by sandbanks. *Odessa*, on the Black Sea, the grand emporium of S. Russia, has rapidly risen to be the second commercial city in the empire. *Taganrog*, on the sea of Azov, is frozen from December to March, but when open the bustle is immense. *Astrakhan*, the chief emporium of the trade of the Caspian Sea, and chief seat of the important fisheries of the Caspian and the river Volga. *Baku* is also rising in importance.

History.

				A.D.
1.	Alfred	began	to reign	871
	Edward the Elder	,,	,,	901
	Athelstan	,,	,,	925
	Edmund I.	,,	,,	941
	Edred	,,	,,	946
	Edwy	,,	,,	955
	Edgar	,,	,,	959
	Edward the Martyr	,,	,,	975
	Ethelred II., the Unready		,,	978
	Edmund II., Ironside	began	to reign	1017
	Canute	,,	,,	1017
	Harold	,,	,,	1036
	Hardicanute	,,	,,	1039
	Edward (Confessor)	,,	,,	1041
	Harold II.	,,	,,	1066

2. The sovereigns of the sixteenth century were:—

			A.D.
Henry VII., died			1509
Henry VIII.,	began	to reign	1509
Edward VI.	,,	,,	1547
Mary	,,	,,	1553
Elizabeth	,,	,,	1558-1603

3. The sovereigns who have reigned in England since 1700 are:—

			A.D.
William III., who died			1702
Anne	began	to reign	1702
George I.	,,	,,	1714
George II.	,,	,,	1727
George III.	,,	,,	1760
George IV.	,,	,,	1820
William IV.	,,	,,	1830
Victoria	,,	,,	1837

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. Find the simple interest on £500 for four years at £5, 7s. 6d. per cent. per annum; and the amount of £2,000 for $12\frac{1}{2}$ yrs. at $3\frac{1}{2}$ per cent. per annum.

2. What amount of capital, put out at $3\frac{1}{2}$ per cent. per annum, simple interest, would produce £14 interest in $4\frac{3}{4}$ years?

3. A farmer, having $37\frac{1}{2}$ score of sheep, sold 8 per cent. of them to A, 90 sheep to B, and $3\frac{1}{2}$ per cent. of the remainder to C. How many sheep had he then left?

4. A woman bought oranges at the rate of 8 for 5d., and sold them so as to gain $1\frac{1}{2}$d. on each dozen. (1) What did she charge for each orange? (2) What did she gain per cent.?

FEMALES.

1. Find the sum of $\frac{3}{8}$, $3\frac{11}{16}$, $10\frac{3}{8}$, and $\frac{9}{32}$.

2. Reduce $\frac{3\frac{1}{3}}{1\frac{1}{13}}$ of $\left\{\frac{19}{120} \text{ of } £1 - \frac{7}{48} \text{ of } 1s.\right\}$ to the fraction of a moidore (a moidore = 27s.)

3. Of a field, $\frac{1}{5}$ is meadow; $\frac{3}{8}$ is arable, and the remainder is 1 ac. 3 ro. 26 po. Find the quantities of meadow and arable land.

Grammar.

1. 'The pass was left; for then they wind
   Along a wide and level green,
   Where neither tree nor tuft was seen.'—SCOTT.

   (*a*) Show, from the above passage, that conjunctions may join both principal to principal sentences, and subordinate to principal sentences.
   (*b*) Parse the participles in the above, and show how participles differ from verbs.

2. In analysis an enlargement is said always to be an adjective, or to partake of the nature of an adjective. If this is so, what parts of a sentence are (properly speaking) capable of enlargement? Give examples of such enlargements.

Geography.

Answer *either* Q. 1 *or* Q. 3, *not both*.

1. What are the chief objects of interest which a visitor to Ireland ought to see? Give the position of each, and describe *one* of them fully.

2. Draw a map, or little sketch-maps, showing the position of Calcutta, British Burmah, Singapore, Labuan, and Hong-kong.

3. Say what you know about the history and character of the British settlements in Africa.

One hour allowed for Females, two hours and a half for Males.

History.

1. Mention the most illustrious of our Saxon and Norman kings, and give briefly your reason for selecting them.

2. Sketch the career of Henry III., and mention any great statesmen who directed the Government in his reign.

3. Give some account of (*a*) Danegelt; and (*b*) Magna Charta.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Elementary*.

Write, in small hand, as a specimen of copy-setting, '*Example and practice are more efficient than precept and theory*.'

Composition.

Write full notes of a lesson on *Ships of war*.

Euclid.

[All generally understood abbreviations for *words* may be used, but no symbols of *operation*, such as —, +, ×, are admissible.]

1. Of what different parts does every proposition consist? What is the *reductio ad absurdum?*
If two triangles have two sides of the one equal to two sides of the other, each to each, and have likewise the angles contained by those sides equal to each other; they shall likewise have their bases or third sides equal, and the two triangles shall be equal, and their other angles shall be equal each to each—viz., those to which the equal sides are opposite.

2. To make a triangle of which the sides shall be equal to three given straight lines, but any two whatever of these must be greater than the third.

ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. (*a*) Interest of £500 for 4 years at $5\frac{3}{8}$ p. c.

$$=£500\times\frac{4\times 43}{800}=£\frac{5\times 43}{2}=£107\ 10s.\quad \text{Ans.}$$

(*b*) Interest of £2000 for $12\frac{1}{4}$ years at $3\frac{1}{2}$ p. c.

$$=£2000\times\frac{49}{4}\times\frac{7}{200}=£\frac{20\times 49\times 7}{8}=£857\ 10s.$$

$\therefore$ Amount $=\underline{£2857\ 10s.}$ Ans.

2. $\left.\begin{array}{r}£3\frac{1}{2} : £14\\ 4\frac{3}{4}\text{ yrs.} : 1\text{ yr.}\end{array}\right\} :: £100 : x.$

$£100\times\frac{28}{7}\times\frac{4}{19}=£\frac{1600}{19}=£84\ 4s.\ 2\frac{10}{19}d.$ Ans.

3. $37\frac{1}{2}$ score $=750$
8 p. c. of $750=750\times\frac{8}{100}=60$ No. sold to A.
After selling 90 more he has $750-150$ or 600 left.
$3\frac{1}{2}$ p. c. of $600=600\times\frac{7}{200}$ or 21; and $\therefore$ the rem. $=600-21$ or $\underline{579}$. Ans.

4. (*a*) 8 oranges cost 5d.
$\therefore$ 1 " " $\frac{5}{8}$d.
and 12 " " $7\frac{1}{2}$d.
$7\frac{1}{2}$d. and $1\frac{1}{2}$d. $=$ 9d the selling price of 12.
$\therefore$ the selling price of $1=\frac{3}{4}$d. Ans.

(*b*) The gain on $\frac{5}{8}$d. $=\frac{3}{4}$d. $-\frac{5}{8}$d. or $\frac{1}{8}$, *i.e.*, $\frac{1}{5}$ of the whole, or $\frac{100}{5}$ which is $\underline{20\text{ p. c.}}$ Ans.

FEMALES.

1. $$\frac{3}{8}+3\frac{14}{15}+10\frac{2}{5}+\frac{9}{22}=13+\frac{495+1232+528+540}{1320}=15\frac{155}{1320}$$
$$=15\frac{31}{264}.\quad \text{Ans.}$$

2. $$\frac{28}{9}\times\frac{13}{14}\text{ of }\frac{152-7}{48}\text{s. to the fraction of 27s.}$$
$$\frac{145}{48}\text{s.}\times\frac{26}{9}\div 27=\frac{145\times 26}{48\times 9\times 27}=\frac{1885}{5832}.\quad \text{Ans.}$$

3. $$\frac{1}{5}+\frac{3}{8}=\frac{8+15}{40}=\frac{23}{40}$$
$\therefore\ \frac{17}{40}=$ rem. $=$ 1 ac. 3 ro. 26 po.
and so to find the meadow and arable land the statements are

For the meadow $\left.\begin{array}{l}17 : 8\\ 17 : 15\end{array}\right\} ::$ 1 ac. 3 ro. 26 po. $\left\{\begin{array}{l}: 3\text{ ro. }24\text{ po.}\\ : 1\text{ ac. }2\text{ ro. }30\text{ po.}\end{array}\right.$
" arable

Grammar.

1. (*a*) *For* is a conjunction connecting the principal sentence 'The pass was left' with 'then they wind . . . was seen.' The latter being a principal sentence (complex). *Where*, an adverbial conjunction connecting the subordinate sentence 'neither tree nor turf was seen' with the principal sentence 'then they wind,' etc.
(*b*) *Left*, complete participle qual. *pass*.
Seen, " " referring to *tree* and *turf*.

Participles differ from verbs in merely attaching themselves to nouns like ordinary adjectives.

2. If an enlargement is always to be an adjective or to partake of the nature of an adjective, then properly speaking the simple *subject* and *object* (generally nouns) are capable of enlargement, as 'The *carrier's* cart stands yonder.' 'Victoria, Queen of England, is also *Empress of India*.' 'I like a boy *of a good disposition*.'

Geography.

1. *See same question answered under candidates in this number of Magazine.*

2. *Gambia*, at the mouth of the Gambia, was founded in 1631 as a place for trading in slaves. It produces palm-oil, gold-dust, and gum. *Sierra Leone*, in the basin of the Rokelle, colonized by free negroes in 1787. It is very unhealthy. *St. Helena* was discovered by the Portuguese, occupied by the Dutch and taken by Britain 1651. It forms a station for ships sailing to India. *The Cape* discovered by Diaz 1487, colonized by the Dutch 1652, taken from them by the British 1795, but afterwards restored. Recaptured 1806. Is the maritime key to India and the East. It produces wool, wheat, and wine. *West Griqualand*, famous for its diamond fields, was ceded to Britain 1873. *Natal* was made a separate colony 1824. *British Kaffraria* was incorporated with Cape Colony in 1866, and *Basutoland* was annexed 1868-71. The climate of South Africa is very dry, but mild and healthy. The soil is fertile where well watered and the vegetation abundant. No forests occur except in Natal. The Island of Mauritius, taken from the French in 1810, exports sugar, rice, coffee, and ebony. It is a valuable calling-place for Indian vessels.

History.

1. Of the Saxon kings mention may be made of *Egbert*, who united the kingdoms of the Heptarchy under the common name of England, 827.

Alfred, the most celebrated of all the Saxon kings, rescued his kingdom from the Danes, established a regular militia, and built a fleet of ships. But it was as a legislator that he earned his greatest fame. He drew up a code of laws which is still considered as the basis of English common law. As a man he was brave, temperate, industrious, and learned, the aim of his whole life being to promote the happiness of his people, and no man ever better deserved the surname of Great.

Of the Norman kings, the most illustrious was William the Conqueror, both for the conquest of England, the compilation of Dooms-day book, the establishment of the Feudal System, and the consolidation of the kingdom.

2. Henry III., succeeding to the throne at the early age of ten, a regent, Hubert de Burgh, was appointed, who soon, by wisdom and prudence, brought back the rebellious nobles to the young monarch. Henry, however, showed the weakness of his character by inviting his wife's relations and other Frenchmen to England. The English were enraged at the bestowal of dignities and offices on these men, and insisted on Henry's summoning a council to redress the national grievances. This council has been generally called 'the mad parliament.' The great champion of the liberties of the people was Simon de Montfort, who, along with eleven others, was appointed to reform the state by the Provisions of Oxford. Henry, however, could not sanction the sweeping measures proposed, and a civil war broke out. The result was that the king and his son, prince Edward, were taken prisoners. The latter managed to escape, and eventually succeeded in defeating and slaying De Montfort at Evesham, 1265.

3. *Danegelt* was a tax levied by Ethelred the Unready for the purpose of buying off the Danes who were spoiling the country. This cowardly plan only caused the enemy to return in larger numbers to demand larger sums. *Magna Charta* was the famous document signed by King John, 1215, confirming many of the chief privileges which free Englishmen still enjoy.

Composition.

NOTES ON SHIPS OF WAR.

Structure.—Heavier and stronger than merchant ships of the same size; decks adapted to bear the weight and recoil of the guns; formerly all built of timber, even after iron was used for trading ships, the splinters of the iron when the plating was penetrated by shot causing great havoc among the crew; now every warship, either wholly or partially, covered with shot-proof armour.

Kinds.—First, second, third-rate line-of-battle ships; frigates, sloops-of-war, ironclads, turret ships, rams, etc.

Parts.—Ships of war designated by the number of decks having complete batteries of guns; may have an orlop-deck, near the water level; lower-deck or gun-deck; the main-deck; the upper-deck, with poop and quarter-deck.

Ships-company.—Captain, first lieutenant, sailing master, purser, midshipmen, boatswain, gunner, sailmaker, carpenter, marines, blue-jackets, etc., numbering in a first-rate upwards of 1000 souls; the strictest discipline required.

Uses.—A maritime country like ours needs a powerful navy for preventing invasion and for the defence of her numerous colonial possessions and dependencies, which are scattered over the surface of the globe.

Euclid.

1. A *proposition* may be either a *problem* or a *theorem*. (1) A problem, which requires some geometrical *construction* to be *effected*, consists of the *data* or *things given*, and the *quæsita* or *things sought;* (2) a *theorem*, which requires some geometrical *property* to be *demonstrated*, consists of the *subject* or *hypothesis*, and the *conclusion* or *predicate*. The connected course of reasoning by which a geometrical truth is established is called a demonstration, and when a result is established by showing that some absurdity follows from supposing the required result to be true, this mode is called the *reductio ad absurdum*. Prop. 4, bk. 1.

2. Prop. 22, bk. 1.

[In consequence of the pressure upon our space, we are compelled to hold over the remainder of these Questions till next month.]

—o—

Publications Received.

Arithmetic—

(1) Ellery's Marlborough Arithmetical Test Cards. II. to VI. W. and R. Chambers.

Domestic Economy—

(1) Fothergill's Domestic Economy for Schools. W. Isbister.
(2) Domestic Economy Test Cards. I., II., III. W. and R. Chambers.

Geography—

(1) Hughes's Class Book of Modern Geography. G. Philip and Son.
(2) Philip's Comprehensive Atlas. G. Philip and Son.
(3) Philip's Student's Atlas. G. Philip and Son.
(4) Philip's Select Atlas. G. Philip and Son.
(5) Philip's Introductory Atlas. G. Philip and Son.
(6) Philip's School Atlas of Physical Geography. G. Philip and Son.
(7) Morrison's Historical Geography. Simpkin, Marshall, and Co.
(8) Morrison's Second Geographical Reader. Gall and Inglis.

Grammar—

(1) Meiklejohn's Standard Grammar. IV. W. and R. Chambers.

Miscellaneous—

(1) Saville's Civil Service Coach. Crosby Lockwood and Co.
(2) Ward and Lock's Pictorial Atlas of Nature. Ward, Lock, and Co.
(3) Jackson's Code Poetical Reader. Burns and Oates.

Music—

(1) The Musical Review.

Periodical Literature—

(1) Ward and Lock's Universal Instructor. X. Ward and Lock.

SCHOLARSHIP EXAMINATION.

ERRATA.

IN consequence of the haste in which our answers to these were drawn up for the press, several more or less serious mistakes have been made. Through the kindness of some twenty correspondents, we point out the following :—

(1) P. 297. Section VI. Ques. 1.
£39 10s. 6d. × 10 is given as £398 9s. od. instead of £395 5s. od. This will make the answer £3 4s. od. less, so that the real result is £537 10s. 9½d.
(F. J. W., J. A. W., H. J. W., and others.)

(2) P. 298. Section VIII. Ques. 2.
For £66,000,000 read £6,600,000. (J. A. W.)

(3) P. 298. Section X. Ques. 1.
We were misled by the question, which contains the words 'The same amount of interest,' to calculate the *amount* instead of the *interest*. Nevertheless M. B. is just a little tedious in the method he suggests. The interest on £500 for 3 years at 5% is £500{(1·05)³ − 1}=£500 (·157625)=£78 16s. 3d. Making this correction, £100 is easily found to be the right answer.
(M. B., J. A. W., and others.)

(4) P. 300. Section IX. Ques. 2.
We have omitted to subtract the breadth of the passage. This gives 9½ ft. instead of 11½ ft., and an area of 9½ × 12 = 114 feet. (J. A. W. and others.)

—o—

Query Column.

*** *Communications for this column must reach the Office not later than the 15th inst., and should be addressed,* 'THE QUERY EDITOR' of the *Practical Teacher*, Pilgrim Street, Ludgate Hill, London, E.C. *Correspondents must in all cases remember to give their true names, not necessarily for publication, but as a guarantee of good faith, and for facility of reference.*

We are now receiving such a number of Queries that we shall be obliged for the future to limit each correspondent to ONE *question. When more than one are sent, we shall, if possible, give slight hints for the solution, or solve the most difficult only. All, however, who adhere to our rule may be sure of having their difficulties fully explained.*

We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

1. 'E. H. S., Sittingbourne, will thank any reader who has passed the Third or Fourth Stage, Mathematics, of the Science and Art Department, to recommend Text Books for the same.'

Correspondents wishing *us* to reply to such questions must enclose in all cases a copy of the latest regulations. They will not then have to wait a month for their answer.

2. Parse the words in italics in—

'O blest *retirement*, *friend* to life's decline,
Retreat from care *that* never must be mine.'

The only difficulty here is with '*friend*' and '*retreat*,' which are in apposition to 'retirement,' and in the same case.

Grammars differ as to '*retirement*.' Some would call it 'appellative nominative,' others 'vocative.'

3. JOHN WILSON, Esq., M.A., F.R.S.E., Bannockburn, is kind enough to send us two solutions to Query No. 21, Aug. 'Find a number of 6 digits with 7 in the unit's place such that, when the left-hand figure is removed to the right hand, the number thus formed is equal to three times the original number.'

The following, being more direct than the one we gave, is worthy of notice :—

Denote the number by

$$a \mid b \mid c \mid d \mid e \mid 7.$$

When a is transposed this becomes

$$b \mid c \mid d \mid e \mid 7 \mid a.$$

But this is three times the ast; ∴ since $3 \times 7 = 21$, $a = 1$.

The number now is

$$b\,|\,c\,|\,d\,|\,e\,|\,7\,|\,1.$$

If we had proceeded to find this figure 7 by multiplication, we get that 7 is the remainder on dividing $3e + 2$ by 10.

This would be the case if $3e + 2 = 17$,

or $3e + 2 = 27$,

and $3e + 2 = 37$ is not admissible, because e is less than 10. Also $3e + 2 = 27$ is not admissible, because e is integral.

Hence $3e + 2 = 17$, $\therefore e = 5$.

The number now is

$$b\,|\,c\,|\,d\,|\,5\,|\,7\,|\,1.$$

Similarly,

$\frac{3d+1}{10}$ leaves remainder 5, $\therefore d = 8$;

$\frac{3c+2}{10}$,, ,, 8, $\therefore c = 2$;

$\frac{3b}{10}$,, ,, 2, $\therefore b = 4$;

$\therefore$ number $= 142857$.

4. JOHN ELKINGTON, Bradford.—Examine the answers to the following questions in 'Practical Arithmetic for Standard VI.':—

Ex. 83. No. 2 in C.

Evaluate $\frac{3}{4}$ of $\frac{1}{6}$ of $\frac{4}{15}$ of $\frac{25}{3}$ of £3 15s.

$$=£\tfrac{15}{4} \times \frac{1}{\cancel{6}} \times \frac{\cancel{4}}{\cancel{16}} \times \frac{\overset{5}{\cancel{16}}}{2} \times \frac{\cancel{16}}{\cancel{4}} = £\tfrac{15}{8} = \text{half the original sum,}$$

$$= £1\ 17s.\ 6d.$$

Ex. 87, No. 6 in D.

$$\cdot 3125 = \frac{3125}{10000} = \frac{5 \times \cancel{625}}{16 \times \cancel{625}} = \tfrac{5}{16}, \text{ and not } \tfrac{1}{32} \text{ as stated.}$$

$\frac{1}{32}$ is of course $\frac{1}{10} \times \frac{5}{16} = \cdot 03125$, and this was probably what was meant.

5. MARY BERNARD, Marlow.—A field exactly forty yards square is crossed at equal distances by four straight walks, each 12ft. wide. What is the size of the equal parts into which they divide the field? and what length of iron hurdles will be required to enclose them?

Total area of field $= 40^2$ square yards	$=$	1600	square yards.
Four paths, 40 yards by 4 yards	$=$	640	,,
Area remaining	$=$	960	,,
Area of each part	$=$	192	,,

(For since *one* path divides the field into *two* portions, *four* paths will divide it into *five* portions.)

What is next required is the amount of fencing which each one of these portions takes.

One side has a length 40 yards; the area is 192 yards; $\therefore$ the other side is $\frac{192}{40}$ yards long $= \frac{24}{5}$ yards. Hence the total perimeter $= 2(40+\frac{24}{5}) = 89\frac{3}{5}$, which is the answer you give.

6. E. L. S., Leeds.—Divide the number 208 into two parts, such that the sum of the fourth of the greater and the third of the less is less by 4 than 4 times the difference between the two parts.

Let $104+x$ and $104-x$ be the parts.

Their difference is $2x$.

Then we have at once

$$\frac{104+x}{4} + \frac{104-x}{3} = 8x-4;$$

$$\therefore\ 3(104+x)+4(104-x)=12(8x-4),$$

$$312+3x+416-4x=96x-48,$$

$$728+48=97x=776,$$

$$\therefore x = 8.$$

Hence the parts are 112 and 96.

7. E. L. S., Leeds.—

Solve $\quad \frac{10}{x} - \frac{14-2x}{x^2} = \frac{22}{9}$.

Multiply throughout by x^2.

$$10x - 14 + 2x = \frac{22x^2}{9}.$$

Or $\quad 22x^2 = 9(12x-14)$;

i.e. $\quad 11x^2 - 54x + 63 = 0$,

$\quad (11x-21)(x-3) = 0$;

$\therefore\ x = 3$ or $\frac{21}{11}$.

8. E. A. S., Birmingham.—Suppose the son receives £x. Then the daughter receives £$(1000-x)$.

Now $\quad \frac{x}{5} - \frac{1000-x}{4} = 10.$

Multiply throughout by 20.

$$4x - 5(1000-x) = 200,$$

$$9x = 5200,$$

$$x = £\frac{5200}{9} = £577\ 15s.\ 6\tfrac{2}{3}d.,$$

Hence the daughter's share is £422 4s. $5\frac{1}{3}$d.

9. J. W. SMITH, Radcliffe.—A field of 7 acres is sown with turnips, beet, and cabbage; the areas of the crops being respectively as $1\frac{1}{3} : 1\frac{1}{2} : 1\frac{1}{4}$. If the values of an acre of each be also respectively in the same ratios, and an acre of turnips be worth £7, what is the worth of the whole crop?

Areas are as $\quad \frac{4}{3} : \frac{3}{2} : \frac{5}{4}$,

as $\quad 16 : 18 : 15$.

Hence $\frac{16 \times 7}{16+18+15}$ acres are devoted to turnips, *i.e.* $\frac{16}{7}$ acres.

An acre of turnips is worth £7;

$\therefore$ whole worth of turnips is £16.

It is obvious that the whole worth of the other crops is as

$$16^2 : 18^2 : 15^2;$$

$\therefore$ whole worth of crops

$$= 16\left\{1 + \frac{18^2}{16^2} + \frac{15^2}{16^2}\right\}$$

$$= £(16 + \tfrac{81}{4} + \tfrac{225}{16})$$

$$= £16 + £20\ 5s. + £14\ 1s.\ 3d.$$

$$= £50\ 6s.\ 3d.$$

10. H. E. S., Ashford.—Your solution would do well enough. We know nothing about the 'marking' of the Scholarship Answers.

11. ENQUIRER, Ossett.—We do not know of any reliable Pronouncing Dictionary of Proper Names. We have already in these columns recommended a Geographical Pronouncing Dictionary.

12. NOVELIST wishes to know what to do with a novel that he has written. The soundest advice we can possibly give him is to burn it. 'Some of the well-puffed fashionable novels of eighteen hundred and twenty-nine hold the pastry of eighteen hundred and thirty; and others which are now extolled in language almost too high-flown for the merits of Don Quixote will, we have no doubt, line the trunks of eighteen hundred and thirty-one' (Lord Macaulay on *Mr. Robert Montgomery's Poems*). Even if 'Novelist' deems this judgment not fitting to his production, he should recognize that very few novelists rise to eminence without being able to spell.

If he persists in wishing the world to see his knowledge, or deplore his lack thereof, he should send it to any one of the best-known publishers of novels, whence there is a not infinitesimal chance that he will get it 'returned with thanks.' We may mention *Elder*, *Hurst*, *Blackwood*, *Nisbet*, and *Murray*.

13. J. T. L., Staplehurst, sends us a letter, part of which is worth quoting:—

'What puzzles me is why so many words and processes are employed [in Geometry]; for instance, to raise from the point B, at the end of the line AB, a perpendicular to the said AB. Without all the directions about compasses, etc., why may I not just clap [*sic*, a not very geometrical expression—ED.] my carpenter's square on the line AB, and the other leg will give me a perpendicular at once? . . . . Does it really mean that before I can slit a board (down the middle, for instance) I must make one of those drawings on the board?'

The main fallacy in this reasoning is to suppose that Euclid is more an end than a means. As a general rule, with of course very marked exceptions, the result of a Geometrical investigation is not in itself valuable in practice. Its importance lies in its being part of a general method, or an illustration of a certain principle, which of itself is capable of application, and often leads to consequences which are of vital interest to the mere mechanician. In other words, Geometry is a species of training, the higher Mathematics and the cultivation of the reasoning powers being the ends in view.

It will be satisfactory to give a few instances of actual application:—

(1) There is a conical hill. A is at one side of it, B is at the other. A wants to bore a tunnel to B, and has no implements but a measuring-chain. The slopes of the hill are very abrupt, so that A can circumvent it, but cannot climb it. He requires to know how many feet in length his tunnel will be.

Your carpenter's square would be little good here, and yet poor despised Euclid is invaluable. Proposition 47, Book I., helps us out of the difficulty at once. Let A walk on the level in any distance in a straight line until he come in sight of B, and then continue to walk on in the same direction until the line in which B appears is at right angles to his path. This point may be found by Euclid i. 12. Suppose he has then walked half a mile. Let him now walk straight to B, which we will say is three furlongs additional. Then the proposition in Euclid to which we referred tells us at once that A was originally five furlongs from B, for $5^2 = 3^2 + 4^2$.

(2) Suppose you want to make a perfect oval. You cannot do it with your tools. Yet higher Geometry shows you at once how to do it with nothing more recondite than two pegs, a piece of string, and a pencil.

14. M. WILLIAMS, Mossley.—No.

15. JOHN ROBERTSON, Glasgow.—The School Correspondent must write.

16. LIZZIE AMOS, Rayne.—The Educational Department do not determine the work, as in the case of males. The words of the syllabus are, 'Parsing and Analysis of a passage in prose or verse from some well-known standard author.'

Write to the Secretary of the College at which you intend to sit.

17. D. R. H., Hull.—We intend to publish Mundella's speech on 'Education.'

We do not think Green's book is out yet.

18. D. A., Nottingham.—Rev. W. F. Moulton, D.D., has written a good book on the subject you name—'History of English Bible.' Publisher, we believe, is Cassell. Dr. Angus also has a book remotely connected with it; publishers, the Religious Tract Society.

19. W., Willington.—Begin with 'Easy Lessons on the Mechanical Powers' (London: Joseph Hughes), then try Browne's 'Elementary Mechanics,' or Magnus's treatise on the same subject.

20. PUPIL TEACHER, Brynman.—Chardenal's series is, perhaps, the best.

21. ISAAC MATTHEWS, Swansea.—A and B engage to do a piece of work for 30s. A could do the work alone in 4 days, and B in 5 days; with the help of a boy it is completed in 2 days: how should the money be divided? (*Barnard Smith.*)

A does work in 4 days,
∴ he can do $\frac{1}{4}$ of work in a day,
∴ he does $\frac{1}{2}$ of work in 2 days.
B does work in 5 days,
∴ he does $\frac{1}{5}$ of work in a day,
∴ he does $\frac{2}{5}$ of work in 2 days.

There is only $\frac{1}{10}$ of work left, and the boy does this. Hence A should have $\frac{1}{2}$ of the total pay, *i.e.*, 15s.; B $\frac{2}{5}$ of the pay, *i.e.*, 12s.; and the boy 3s.

22. R. K. S., Clapton.—A person travelled from London to Loch Lomond (480 miles), by sea, rail, and coach. The distance by coach was $\frac{1}{3}$ that by rail, and the distance by rail was $\frac{3}{10}$ that by sea. How much did the whole journey cost, coach fare being 4d. per mile?

There are obviously too few facts given. If we represent the distance by sea by 10, that by rail is 3, by coach 1;

∴ $\frac{10}{14}$ of journey was by sea, *i.e.*, $342\frac{6}{7}$ miles.
$\frac{3}{14}$ " " rail, *i.e.*, $102\frac{6}{7}$ "
$\frac{1}{14}$ " " coach, *i.e.*, $34\frac{2}{7}$ "

Hence the journey by coach cost $136\frac{8}{7}$, or $137\frac{1}{7}$ pence. This is as far as we can go. To get your answer, £2 10s., by Conjectural Emendations would be waste of time.

23. D. J. H., Airdrie.—A certain fraction exceeds $7\frac{1}{8}$ by $5\frac{1}{12}$; another is less than $5\frac{1}{6}$ by $3\frac{1}{4}$: find the product of the sum, and difference of the two fractions.

$$\begin{aligned}
\text{First fraction } \ldots &= 7\tfrac{1}{8}+5\tfrac{1}{12} = 12\frac{3+2}{24}\\
&= 12\tfrac{5}{24}\\
\text{Second fraction} &= 5\tfrac{1}{6}-3\tfrac{1}{4} = 1\frac{28-6}{24}\\
&= 1\tfrac{22}{24}\\
\text{Sum of these } \ldots &= 13\tfrac{27}{24} = 14\tfrac{1}{8}\\
\text{Difference } \ldots &= 10\tfrac{7}{24}\\
\text{Product of these two} &= \tfrac{113}{8}\times\tfrac{247}{24}\\
&= \tfrac{27911}{192}\\
&= 145\tfrac{71}{192}
\end{aligned}$$

24. D. J. H., Airdrie.—Try Gill's Drawing-books.

25. A. P., London.—We are sorry to disappoint you, but we really can't understand your Questions. They are far too technically worded. You can't expect us to be a walking Cyclopædia of everything, including Railway Clearing House abbreviations.

26. R. HAIL, Camberwell.—We think the answer should be £46 9s. 4d., instead of £49 9s. 4d.

£46 9s. 4d. $= \frac{1}{30}$ £(1394) $= \frac{1}{30}$ {1987 − £397 8s. − £195 12s.} = etc.

27. CHELTONIAN, Newchurch.—Ash saplings after 5 years' growth are worth 1s. 3d., and increase in value 1s. 3d. each year afterwards. For their growth they require each twice as many square yards as the number of years they are intended to grow before cutting. A plantation is arranged so that each year the same number may be ready for cutting. Find the greatest annual income which can be obtained per acre, allowing 20 per cent. for expenses. (St. John's College, Cambridge, December, 1870.)

We think there must be some mistake in the sum as you have quoted it. We cannot obtain your answer, nor do we at present see any but a very complex *Arithmetical* solution. By Algebra, of course, it is easy.

28. NERO, Pontypridd.—In a triangle if the lines bisecting the angles at the base be equal, the triangle is isosceles.

We give the following Trigonometrical proof. A Geometrical proof is easy by *reductio ad absurdum*, or directly as in the *Appendix* to Todhunter's *Euclid* (Macmillan, 3s. 6d.).

ABC be △. BE bisect ABC, CF, ACB.

$$BE = CF, \therefore \frac{a \sin C}{\sin\left(A+\frac{B}{2}\right)} = \frac{a \sin B}{\sin\left(A+\frac{C}{2}\right)}$$

$$\therefore \sin C \sin\left(A+\frac{C}{2}\right) = \sin B \sin\left(A+\frac{B}{2}\right)$$

From this equation easily C = B.

29. A. L. BALL, Cardiff.—We have answered your question before in the *Query Column*.

30. VERITAS, Sandown.—How long will a train 280 ft. in length, going at the rate of $18\frac{1}{2}$ miles per hour, take to pass a train 182 feet long, coming in opposite direction at rate of 34 miles an hour?

The rule (see *Query, No.* 17, June) is, Add the rates and add the lengths, and find what time a point moving with the total rate takes to travel the sum of lengths.

Total rate $52\frac{1}{2}$ mls., length 462 ft.
60 mls. per hour is 88 ft. per sec.

$52\frac{1}{2}$ " " $\frac{105}{120}\times 88$ "

" " 1 $\frac{120}{105\times 88}$ secs.

" " 462 $\frac{\overset{6}{\cancel{462}}\times\cancel{120}}{\cancel{105}\times\cancel{88}}$

Answer, 6 seconds.

31. R. GIBBONS.—Your data are insufficient.

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add together eight thousand four hundred and nine, six hundred and eighty-seven, nine thousand four hundred and ninety, seven thousand eight hundred and sixty-seven, and twenty-three. Ans. 26,476.

(2) From six thousand four hundred and two, take eight hundred and forty-seven. Ans. 5,555.

(3) Take one hundred and forty-two from two hundred and sixteen. Ans. 74.

STANDARD II.

(1) Multiply ninety-eight thousand seven hundred and fifty-six, by six hundred and eight. Ans. 60,043,648.

(2) Divide twelve thousand and fifteen, by seven. Ans. 1,716 + 3.

(3) Take nineteen thousand five hundred and forty-seven, from twenty-six thousand and eleven. Ans. 6,464.

(4) Find the sum of seven hundred and eleven thousand six hundred and ninety, ninety-nine thousand and thirty-six, two hundred and twenty-six thousand four hundred and nine, seven hundred and forty-three thousand six hundred and fifty-four, and two hundred and sixty thousand four hundred and twenty-four. Ans. 2,041,213.

STANDARD III.

(1) Divide five hundred thousand five hundred and forty-four, by eight hundred and sixty-nine. Ans. 576.

(2) From ten thousand pounds and a farthing take nine thousand seven hundred and sixty-four pounds seventeen shillings and a farthing. Ans. £235 3s.

(3) Add together one hundred and seventy-five pounds ten shillings and ninepence, one hundred and ninety-four pounds fifteen shillings and eightpence, seventeen thousand one hundred and sixty-four pounds sixteen shillings and sevenpence halfpenny, nine hundred and ninety-nine pounds two shillings and sevenpence, sixty-seven thousand eight hundred and sixty-four pounds nineteen shillings and elevenpence three farthings, six hundred and forty-two pounds three shillings and eightpence halfpenny, eight thousand seven hundred and sixty-four pounds nine shillings and twopence halfpenny, and six hundred and forty-eight pounds two shillings and sixpence. Ans. £96,454 1s. 0¼d.

(4) I spent 1s. 1d. on sugar; 1s. 1½d. on bacon; 2s. 10d. on ham: 4s. 2½d. on currants; 6d. on soap, and 3½d. on cheese. If I offered a sovereign as payment, what change ought I to receive? Ans. 9s. 11½d.

STANDARD IV.

(1) If one horse cost seventy pounds eleven shillings and tenpence farthing, what would forty-nine cost? Ans. £3,459 0s. 10¼d.

(2) How many inches are there in a telegraph wire measuring four miles and five hundred and sixty yards? Ans. 273,600 inches.

(3) Divide seven hundred and ninety-nine pounds fifteen shillings and tenpence farthing by eighty-nine. Ans. £8 19s. 8¼d. + 87.

(4) Find the sum of thirteen guineas, nine half-crowns, twenty-five sixpences, fifty-four shillings, and twenty-seven pence. Ans. £18 4s. 3d.

STANDARD V.

(1) If a pound of sugar cost threepence, find the worth of ten cwts., three qrs., and two pounds. Ans. £15 1s. 6d.

(2) Find by Practice the cost of a hundred articles at sixteen pounds three shillings and fivepence a-piece. Ans. £1,617 1s. 8d.

(3) A draper bought 916 yards of cloth at 15s. 9¼d. per yard, and sold it again at 17s. 6d. per yard. What did he gain? Ans. £79 3s. 11d.

(4) A bill—

7 yds. @ 6s. 6d. per yd.; 24 yds. @ 11½d. per yd.; 16 yds. @ 7d. per ft.; 19 reels @ 3d. each; and 8 yds. @ a farthing a yd.

	£	s.	d.
	2	5	6
	1	3	0
	1	8	0
	0	4	9
	0	0	2
Ans.	5	1	5

STANDARD VI.

(1) Reduce

(*a*) 5½ ounces to the decimal of 1 lb. Ans. ·34375.

(*b*) 1·25 to a vulgar fraction. Ans. $\frac{5}{4}$.

(2) If 7 men mow a field of fifteen acres in six days, in what time will 24 men mow a field of twenty-eight acres? Ans. $3\frac{4}{15}$ days.

(3) Simplify

$$\frac{3\frac{1}{2}+\frac{5}{8}-\frac{3}{4}}{6\frac{2}{3}\times\frac{3}{10}} \qquad \text{Ans. } 1\frac{11}{16}.$$

(4) Divide the product of 756·08 and ·035 by ·005. Ans. 5292·56.

History.

SET TO STANDARDS IV., V., AND VI.

(1) What memorable events occurred in 1588, 1688, 1715, and 1759?

(2) Give some account of Drake, Strafford, Judge Jeffries, and Sir John Moore.

(3) Describe the growth of our Indian Empire.

(4) Who were Edward VI.'s ministers? On what plea was Edward VI. induced to desire Lady Jane Grey to be his successor? How was she connected with the Royal family?

Grammar.

STANDARD IV.

Parse:—

(*a*) The sun shines bright.
(*b*) The swan is a very gentle bird.
(*c*) The Assyrian came down like a wolf on the fold.

STANDARD V.

Parse and analyse:—

(*a*) After a few minutes he put his hands into his pockets.
(*b*) The warrant for the execution of Mary was unwillingly signed by Elizabeth.

STANDARD VI.

Parse and analyse:—

(*a*) Carlo, for that was the dog's name, was taught to be useful.
(*b*) He begins to work as soon as he begins to live.

THE HARVEST FIELDS.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.

The Practical Teacher.

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The Editor cannot return rejected MSS.; authors should therefore retain copies.

IMPORTANT NOTICE.

THE August and September issue (Nos. 6 and 7) of the *Practical Teacher* will contain the Scholarship Questions, July, 1881, with model answers to every question in every subject. *Early orders should be given to the Booksellers.*

☞ In reply to numerous inquiries, the Editor begs to state that a Series of Papers of special interest to Schoolmistresses will shortly appear in this journal. The first will be entitled 'How I Teach Needlework.'

Monthly Notes.

THE RIGHT HON. A. J. MUNDELLA, M.P., AND PUPIL TEACHERS.—The Right Hon. A. J. Mundella, M.P., presided at the distribution of the prizes to the pupil teachers of the Westminster Teachers' Association, on the 27th July. Mr. Mundella was accompanied by Mrs. Mundella, Mr. Sydney Buxton, Mr. G. Potter, Mr. J. R. Langler, B.A., and others. Mr. Mundella, in the course of his address, said the Department with which he had the honour to be connected could do very little in the way of local assistance to pupil teachers. They could provide a code, give grants, and conduct examinations, but they could not supply that local interest which took care of the studies and the religious training of the pupil teachers, and which no central department of the Government could furnish. With regard to pupil teachers, they had entered upon a most honourable and dignified profession, at a time much more favourable for teachers than the times which had passed. There was a growing appreciation of the work of the teacher, and of the dignity of the teacher's office, in the minds of the people of this country. In conclusion the right hon. gentleman cautioned the pupil teachers not to be grant-earners or crammers, but to follow the example of those who were above the consideration whether they earned a few pounds more or less, and who had, in their classes, attained the best educational results. Mrs. Mundella then distributed the prizes.

SOUTHLANDS COLLEGE.—The Rev. G. O. Bate, Secretary of the Wesleyan Education Committee, has been appointed Principal of the Southlands College, Battersea, in place of the Rev. G. W. Olver, B.A.

THE GOFFIN CASE.—In the House of Commons, on the 8th August, Lord George Hamilton, in a long speech, brought forward the case of Mr. Goffin, headmaster of the United Westminster School, who in 1879 was found guilty by a Select Committee of a systematic course of fraud, falsehood, and subornation, in connection with the examination of the Science and Art Department, but who nevertheless has been retained in his position by the Governors. He spoke as to the antecedents of Mr. Goffin, and of his conduct at Exton and Woking, and said that, had the forms of the House permitted it, he would have moved a formal vote of censure on the Board. Mr. Warton, who rose after Lord George Hamilton, said that Mr. Goffin was a man of preeminent ability and high character, and contended that, as the Department and the school had parted company, the House had nothing further to do with the matter. Sir S. Waterlow defended the course pursued by the Governors, who thought that Mr. Goffin had been addicted to over-cramming, but acquitted him entirely of fraud. He censured the manner in which the inquiry had been conducted, and challenged the Department to prosecute Mr. Goffin. Sir J. C. Lawrence also defended the Governors; but Mr. Errington, as a member of the Committee, agreed with Lord George Hamilton. After some remarks from Mr. O'Donnell, Mr. Mundella said that in his opinion Mr. Goffin was guilty, that the Governors had made a great mistake in allowing him to continue in his office, and that the whole affair was a scandal. The House then went into Committee of Supply.

TRADES GUILD OF LEARNING.—A meeting of the supporters of the Trades Guild of Learning was held on the 8th August, in the Hall of the Society of Arts, the Earl of Rosebery presiding. His Lordship in opening the proceedings said they all knew that there were great technical schools coming, the foundation-stone of which had been laid the other day in London, and the same class of school abounded in France, Germany, and Switzerland, which did an immense deal of good to the workmen of those countries, and an immense deal of harm to the workmen of this, by the competition of the former. The great object of such

a Guild as theirs was not so much to give practical or manual instruction in the different handicrafts, as to teach the spirit and history of them. Such a society as this ought to have its work inspired by working men, and, unless they could obtain the hearty co-operation and support of the latter, he for one would be no party to the continuance of the association. Mr. Thomas Burt, M.P., then moved, 'That this meeting approves and pledges itself to support the objects proposed by the Trades Guild of Learning; viz., (1) To provide lectures on the history and principles of various industries, with a view to encourage the desire for improved technical education; and (2) to continue the general education which the Guild has carried on for some time by means of lectures and classes.' Mr. G. A. Sala seconded the motion, which was carried unanimously. Mr. H. Pratt moved, and Mr. Phillips seconded, the following resolution, which was agreed to:—'That the trade societies should be urged to co-operate as far as possible in organizing the proposed lectures and classes, and that the council should specially invite the support of the large employers of skilled labour in London.'

LIVERPOOL UNIVERSITY COLLEGE.—The scheme for establishing a University College at Liverpool is advancing. A petition, which has been signed by Lord Derby, Mr. Rathbone, M.P., Mr. Robert Gladstone, and Sir J. A. Picton, and which prays for the grant of a charter of incorporation, having been presented to the Privy Council, a charter has been granted in accordance with the suggested draft; and the council have already purchased a site for the necessary buildings.

THE NATIONAL THRIFT SOCIETY AND MR. MUNDELLA.—An important deputation from the National Thrift Society had an interview with Mr. Mundella at the Education Department on July 21st. The deputation consisted of Mr. Robert Freeman, Vice-Chairman of the London School Board, Colonel Jasper Willett, Mr. William Botley, M.S.A., Dr. J. Fosse-Harding, F.R.C.S., Major-General Batten, Mr. Hugh Owen, Rev. J. Russell, M.A., Major de Winton, Messrs. Alfred Knight, William Shaw, F. P. Doremus, E. Granville Eliot, and Mr. T. Bowden Green (Secretary of the National Thrift Society). Letters regretting their inability to attend the deputation had been received from Viscount Lymington, M.P., Mr. Samuel Morley, M.P., the Hon. and Rev. E. Carr Glyn, M.A., Mr. James Ranken, M.P., and Dr. N. H. Stevens, C.C. The deputation was introduced by Mr. Robert Freeman, who stated that the gentlemen present and others connected with the National Thrift Society had given a great deal of time and attention to the subject of Thrift being taught to the children at elementary schools; they had therefore come to offer the co-operation of the Society in practically carrying out the principles of Thrift which the Education Department was desirous of inculcating.—Mr. Mundella, in the course of his reply, said he could only express his gratitude for such 'a very opportune and very encouraging' visit. The National Thrift Society could help immensely in various ways, both through their own agencies and the agency of the London School Board. Mr. Freeman, as the Vice-Chairman of the Board, could induce that body to take up the matter, and to decide that every school and every branch of each school should have in connection with it a penny bank established by the National Thrift Society. Having assured those present that the Department were fully prepared to render the Society every possible assistance in the matter, the deputation thanked Mr. Mundella and withdrew.

Gossip.

It is with pleasure that we draw the attention of our readers to Mr. Mundella's speech, on August 8th, 1881, in the House of Commons, and to the 'Proposals for a New Code,' both of which appear in another part of our issue.

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We venture to think that, on the whole, they will prove highly gratifying to the profession, as many of the worst features of the old *régime* have disappeared.

***

Perhaps the two greatest boons promised are the abolition of (1) *the individual payment for the individual pass*, and (2) the endorsement of a teacher's certificate when of the first class.

***

Clause 41 is a concession which all felt must come sooner or later. It provides that 'no certificate shall be cancelled, suspended, or reduced until the Department has informed the teacher of the charges against him, and has given him an opportunity of explanation.

***

That such fair and equitable dealing should not have been the rule hitherto seems monstrous.

***

'Not more than three pupil teachers will be allowed in any school or department, whatever number of certificated teachers may be employed.' This is meant, doubtless, to remedy in a slight degree the glut in the educational market.

***

Many eyes will be opened wide upon reading that portion of Mr. Mundella's speech which states, 'there will be some 76,000 school teachers without hope of employment when they have finished their apprenticeship.'

***

On the face of these figures, it is hard for us to understand why, when one side-door to the profession is shut, another should be opened to *incompetent* men and women simply because they hold a university degree which may, or may not, be worth the having.

***

We write *incompetent* advisedly. The mere possession of a degree is no adequate qualification for the office of a teacher. Nor is the year's practice in an elementary school, which it is proposed these persons shall have.

There is a science and art of teaching, and it would afford us pleasure, as it would nearly every teacher in the country, to learn that no one would be permitted to practise the art who had not had the discipline of an apprenticeship and the training of a normal college.

⁂

What struck us most forcibly upon reading the 'speech' and 'Proposals' was, the number of concessions made through the direct influence of the National Union of Elementary Teachers. And yet there are people who say that the National Union of Elementary Teachers is a failure. We hope these good people, who will benefit by the coming changes, will see their error and join one of the local associations without delay. Any information may be had gratuitously from the courteous and indefatigable Secretary of the Union, Mr. T. E. Heller, 7, Adam Street, Adelphi, W.C. Whilst congratulating the Union upon what it has done, we are no less sincere in doing honour to Mr. Mundella for the noble effort he has made to place the education of our country on a sound basis.

⁂

The Rev. D. Waller has been appointed secretary of the Wesleyan Education Committee in place of the Rev. G. O. Bate, who goes to Southlands as the new principal of that college.

⁂

Many of our readers will regret to hear that by the time they receive their PRACTICAL TEACHERS the Royal Polytechnic Institution will be a thing of the past. This once popular home of pleasant scientific instruction has collapsed.

⁂

Dean Stanley, whose death, in the end of July, filled a whole nation with grief, will ever be remembered as an accomplished scholar and a liberal-minded Churchman. He was certainly the best Dean which the old Abbey has known.

⁂

The last literary work on which he was engaged, was a short critical article on Robertson of Brighton, which will shortly appear in the pages of *Scribner's Monthly*.

⁂

Mr. Elliot Stock will issue a magazine entitled the *Bibliographer* in the autumn; it is to be uniform in size and style with the *Antiquary*, and will be devoted exclusively to book-lore.

⁂

Mr. Matthew Arnold has done a good work in making his *Selections from Byron*. The few words of introduction to the chosen poems are well and wisely written, and in conjunction with the text which they preface, form a fine monument to one whose poetry has not yet been properly appreciated. Mr. Arnold thinks that Wordsworth and Byron will remain the great literary heroes of the nineteenth century.

⁂

A copy of *Three Ways of Spending Sunday, by Timothy Sparkes*, which is one of the earliest and rarest of Dickens' writings, has been sold in Manchester for £6 15s.

Messrs. Bickers are re-issuing in monthly parts, Mrs. Cowden Clarke's admirable *Concordance to Shakspere.*

⁂

Apropos of Shakspere, we may state that Messrs. G. Routledge and Son are now issuing an *édition de luxe* of the works of our national poet, which will probably prove the most beautiful ever printed. It will consist of fifteen volumes, in imperial 8vo, and one thousand copies only will be printed. Eight hundred illustrations by Sir John Gilbert, R.A., will be printed on real China paper, and mounted in the text. Messrs. Clay, Sons, and Taylor are the printers.

⁂

Messrs. C. Kegan Paul and Co. will issue in the early autumn a work which will prove of much interest to scholars and men of letters. We refer to the *Liturgical Poetry of Adam de St. Victor*, translated from the Latin by the Rev. D. S. Wrangham, M.A., Vicar of Darrington, Yorkshire. St. Victor's poetry has long been celebrated as possessing much beauty, and many of his best hymns have been rendered into English by Archbishop Trench. Mr. Wrangham's translation will be issued, side by side with the original Latin, in three crown octavo volumes.

⁂

We are very much pleased to see that Mr. Mundella has announced that attention will be paid in the forthcoming code to good literature, and that Shakspere and Milton will be read in the upper standards. This is as it should be.

⁂

Messrs. G. Philip and Son have just issued a new edition of Professor Hughes's *Class Book of Modern Geography*. The work has been revised and considerably extended. A full notice of it appears in another column.

⁂

We are also glad to hear that the 'North of England School Furnishing Co.' will shortly issue, for 1881, their useful pamphlet, entitled, *What Her Majesty's Inspectors say*. The original arrangement of the text renders it of especial value to elementary teachers.

⁂

Mr. Justin M'Carthy's *History of Our Own Times*, which has proved so successful a work, has been translated into French by M. Leopold Goirond.

⁂

Dr. Hill Burton, Historiographer-Royal for Scotland, and one of Her Majesty's Commissioners for Prisons, died at Edinburgh on August 10th. Dr. Burton, who was in his seventy-second year, will be chiefly remembered for his well-written *History of Scotland*, which is undoubtedly the standard work on the subject. He was also the author of several well-known books, and contributed to the *Westminster*, *Edinburgh*, and *North British Reviews*.

⁂

It is rumoured that Mr. Matthew Arnold will probaby retire from his present post as H.M.I., after completing his next report; and will then devote himself absolutely to literature and politics.

Messrs. Smith, Elder, and Co. will shortly publish a birthday-book, the designs for which have been executed by H.R.H. the Princess Beatrice. We hear that the work will be exceptionally beautiful. English printers are grumbling because the much-coveted work is being done abroad.

***

We hear that the third volume of Dr. Geikie's *Hours with the Bible* is in the press, and will be published very shortly. It embraces the Bible History from Samson to Solomon, and has sixteen illustrations. Messrs. Partridge and Co. are the publishers.

***

It is said—on German authority—that the book which has obtained the greatest number of readers in recent times is *Notre Dame de Lourdres*, by M. Lassere. This work has now reached its 150th edition.

***

The international Geographical Congress, which is to be held at Venice, in September, will be attended by Lord Aberdare, President of the Royal Geographical Society, Sir Henry Layard, and Mr. John Ball, who will go as the official representatives of England.

——o——

Publications Reviewed.

Murby's Imperial Grammar and Analysis. London: T. Murby, Bouverie Street, Fleet Street.

This Grammar is a great improvement on the mass of school grammars. It is clear, well-arranged, and to a considerable extent explanatory. Another almost peculiar feature is that it is progressive, beginning with a first course, or simple explanation of the Parts of Speech, to a second, in which these are treated of more in detail. Next follows a course of Syntax, with clear directions for Parsing. A course of Grammatical Analysis, or completion of Syntax, follows in a variety of useful explanations, given to aid the young student. A very serviceable chapter on Composition ends this useful little book.

With some of the definitions we should disagree, and also with the introduction of some new terms involving no apparent improvement on the old ones. This is common with many writers of grammar books. The chapter on Composition could be judiciously enlarged, together with the Hints on Style, which are so good that we wish there were more of them. We do not like the omission of the term *adjective pronoun*, and the absorption of these by the personal and interrogatives. The adjective pronoun in the sentence, 'This is *my* book,' is different and distinct from the personal possessive, 'This book is *mine*.' The including of the 'Article' under the 'adjective' is also open to objection, though advocated by many. In *a book*, or *an apple*, the terms *a* and *an* fail to carry out the idea of an adjective by giving any idea of the quality of the noun. The hints for Letter-writing are remarkably good, and might be extended to include forms of address to titled and other important personages.

Historical Reader. Standard IV. **Great Events in English History.** By E. Berkley. London: T. Laurie, Stationers' Hall Court.

The first chapters of this book, treating of the Britons, Romans, and Saxons, led us to expect a series of sketches in chronological order. But at the death of Henry III. we jump to the reign of Edward IV. and the murder of the princes in the Tower. Next follows an account of the Gunpowder Plot and the Great Fire of London. After this we are taken back to the Feudal System, the times of Edward I. and Edward III., the French Wars, and so on down to the Wars of the Roses. Next comes a sketch of the Battle of Waterloo, after which we are taken back to the Reformation, the Tudor Kings, and thence to the Stuarts. Now why these sketches could not be chronologically arranged, we see nothing in the book to justify. A few remarkable sketches from Macaulay or other brilliant writers might be expected to occupy places in general reading-books without regard to chronology, but a series of sketches by one writer which dodges needlessly backward and forward is perplexing and unsatisfactory. Altogether these sketches are generally well written, and in a style very suitable for the upper classes in schools. The account of the defeat of the Spanish Armada is a plain and spirited narrative of this signal event in England's history. The bad influence of Charles II. over English morals is also well described. An extensive list of questions occupies the last twenty-four pages in the book.

Marshall's Descriptive Geography Readers. Book II. **The British Isles.** London: John Marshall and Co., 42, Paternoster Row.

We suppose the words Geography and History must be allowed to be used adjectively, and with this preliminary objection we have much pleasure in drawing attention to the beautifully printed, more beautifully illustrated, and altogether useful and attractive book of Mr. Marshall's. Many of the illustrations are gems of wood-engraving, as *A Kentish Lane*, p. 131; *A Rustic Bridge*, p. 125; *Hop Gathering*, p. 75; *On the Tyne*, p. 57, and many others. All are, in fact, excellent.

The first chapter opens with a picturesque description of a British village some 2,000 years ago, and is followed by a short sketch of the advent and departure of the Romans, a short glance at the coast of England, a brief account of the principal river basins, and next of the most prominent features of our manufactures, agriculture, and commerce. A few of the leading railways are next succinctly described, together with the most striking features of a few English counties. Wales and Scotland are next briefly sketched, and the book ends with a short account of Ireland. A prevalent tone of the book is plain, yet not unattractive description, apart from fine writing or poetical allusions, which in a book on this subject for young readers would be out of place.

Henry's First History of England. Laurie's Kensington Series. Standards II. and III. London: T. Laurie, Stationers' Hall Court.

Mr. Laurie tells us in his introduction that the Ancient Britons 'at first lived in caves; but afterwards they made huts of basket-work for themselves, of a round form, somewhat like bee-hives.' Notwithstanding the researches of modern scholars, Pike, Nicholas, and others, we scarcely open a book on elementary history that does not contain the usual nonsense about the Britons being a mere horde of savages, etc., etc. Here we find them relegated to the cave-dwellers. A glance in one of the rooms of the British Museum will show the exquisite specimens of gold and other ornaments used by these so-called 'savages,' who also had well-constructed war-chariots, and a priesthood so renowned for learning as to cause Britain to be resorted to as a seminary to the students from Gaul. We need pursue this matter no further, and are sorry to admit that Mr. Laurie herein has a numerous company of writers who agree with him. After taking leave of the Britons, Mr. Laurie gives us some well-written sketches of the leading features of the Saxons, Danes, and so on to the Norman Conquest. Hence we are taken by chapters remarkably adapted for juvenile reading along the leading lines of English history, in

which the most salient features are simply and clearly described. Now and then the generally easy flow of the narrative is broken by short, jerky sentences, as the following :—

'Simon de Montfort was killed soon after in a battle.
'The king died in 1272.
'You see that the only good done during his reign was not done by him, but very much against his wish.
'Henry III. had four children—two sons and two daughters.
'A remarkable man, called Roger Bacon, who invented a number of useful things, lived in this reign.'

The characters of the kings and others are given with fairness, are not unduly obtruded, and the style altogether is well adapted for juvenile readers. The first book, for Standard II., carries us down to the death of Richard III. at Bosworth. After which the subject is taken up for Standard III. to the present time.

Third Geographical Reader, for Standard IV. Part II. **Scotland, Ireland, the Colonies and Dependencies.** London: W. Isbister, Ludgate Hill.

This book forms the second part of the two devoted to the British Empire, the preceding one taking up England and Wales for Standard III. Like the rest of the series, the volume before us is a model in the way of printing and illustration. The maps, too, are good. The text combines a systematic description of their countries mentioned, together with their principal historical associations, and is written in clear and lucid style. Portions to be committed to memory are placed at the end of each chapter. The explanation of geographical terms and names receives very properly due attention. After some judicious remarks on the nature of colonies, the author thus clearly distinguishes his dependencies or possessions from colonies in general: 'There are also many islands and countries in foreign lands which are held by our Government and peopled to some extent by English men and women, but which are not, strictly speaking, "colonies" because they are not tilled or cultivated by our countrymen. These places are styled "British possessions," because they are "possessed" by the British.' Such explanatory remarks, though most needful, occupy little space in ordinary geographies. Equally worthy of attention is the remarkable fact that 'there does not exist any where in the world a town or district of English-speaking people under an alien power. The same cannot be said of any other race.' Much more might be quoted equally satisfactory from this capital little book—not so little, by the way, as it consists of nearly 300 pages. In describing India the following judicious remarks do much to account for our success in the country :—'The manufactures of India were formerly domestic industries, conducted by special castes, each member of which worked at his own loom and in his own village. One of the results of British rule is the growth of mercantile towns. Our rule derives its origin from our commerce: from the first our efforts were directed towards creating centres from which to export and import goods. The Portuguese, the Dutch, the Danes, and the French had all failed in this respect; but we succeeded, and the two great capitals of commerce, Calcutta and Bombay, were made great under British control.' With such explanations, geography will not only be learned, but understood.

Philips' Introductory Atlas. 24 Maps, with Consulting Index.

Philips' Atlas of Physical Geography. New and Cheaper Edition.

Philips' Student's Atlas. 48 Maps, with Index.

Philips' Select Atlas. 36 Maps.

Philips' Comprehensive Atlas. 42 Modern Maps, and 18 Ancient Maps, with Index. London: G. Philip & Son, Fleet Street.

When we state that the above five atlases form a portion of a list of thirty-two, commencing with a threepenny one, containing sixteen maps, and including the excellent guinea 'Historical Atlas,' and the scarcely less valuable 'Training College Atlas,' we indicate the spirit with which Messrs. Philips have taken up this branch of educational publications. A cursory examination at any one of the series will satisfy any one of the excellent manner in which they are got up. They are clear, beautifully engraved, and carefully coloured. The names are introduced with great judgment, and, while fairly adequate to the countries represented, are free from the common fault of overcrowding. A copious index accompanies each of the larger atlases, with the latitude and longitude of each place mentioned. In the 'Introductory Atlas,' we should have preferred the substitution of a map of Turkey in lieu of Prussia, which latter is contained in that of the German Empire. The books are also strongly bound—no slight advantage in regard to an atlas—and as strongly fixed in strong cartridge backing. Another important desideratum is that of price; and when we have in Messrs. Philips' series beautifully executed maps at a penny each, the slight additional cost in regard to each book being involved in the binding and copious index, we have said enough to show that these books are cheap as well as good. The two series of outline maps—No. 31 on the list—are also most useful, and supply a widely felt want.

The 'Atlas of Physical Geography' will be very useful to students in these days, when so much attention is most properly given to this branch of the science. In this book we have, in addition to the mountain and river systems of the earth, a very fair general outline of the geological structure of the earth. This, of course, can can be but general and approximate in regard to a subject requiring very much in minuteness of detail. The great rock formations are shown, together with as much of other leading features as can be shown on a Mercator map. The first map of this Physical Atlas is remarkably clear and useful. In addition to the general configuration of the land and water, it shows the position and extent of the low-lying lands, the same in regard to the moderately elevated plains, and also the position and general features of the highest regions, on which the great mountain ranges are drawn. Some very pretty illustrations of Botanical and Zoological Geography are given, to show the general distribution of plants and animals as mainly depending on climatical laws, and consequently on elevation as well as latitude. Another suggestive map shows the distribution of man, and the comparative density or sparseness of the populations of the earth, together with the prevalence of the principal religions of the human race. In this the vast districts marked 'Heathen' show how much there is yet to be done for the spread of Christianity and its civilizing influences.

Class Book of Modern Geography. By William Hughes, F.R.G.S. London and Liverpool: G. Philip and Son.

This excellent text-book of Geography has been revised and brought down to the present year by Mr. J. Francon Williams, whose work has been done most satisfactorily in all respects. The name of William Hughes is, of itself, a passport to the accuracy and merits of any book on Geography, and there is no reason why the work before us should not take the place among the first, if not of itself *the first*, of geographical class-books. In addition to unfailing accuracy, this book possesses some unusually meritorious features. Among these are series of the best geographical questions to be met with. These are adapted both for oral and written tests, and both these methods should be extensively pursued in every geographical lesson. Next we may notice the value of the explanations

and derivations of geographical names. These are in most suitable cases traced to original sources, instead of being merely copied from second-hand or questionable authorities. In referring to the river names of most European countries the Celtic origin is often given, and thus we are led to the Sanscrit, the oldest form of European speech, from which most of our river names especially were derived. We are sorry in some instances that more frequent use was not made of Celtic or Cymric roots. In regard to the name *Cotswold*, we are told that the word originated 'probably from the *cots* for sheep and *wold*.' Now the word in question comes from the Welsh *coed*, a wood, to which was afterwards added the Teutonic *wold* of the same meaning. This example of the duplication of names by different races is by no means uncommon, as Harrow-on-the-Hill, where we have the elevated definition thrice given. We wish this explanation of names had also been carried further in the capital book before us, especially in regard to the names of our English counties, notwithstanding that some disputes would probably hereon arise. We should also like to see the short chapter on Mathematical or Astronomical Geography enlarged and accompanied by more explanatory remarks. In mentioning the depression of the earth at the poles, for instance, illustrations even as familiar as the whirling of a mop could be given. But these are trifling shortcomings in comparison with the general excellence of the book.

As examples of the bringing down of this book to modern times, we have a general summary of the recent events in Afghanistan down to June, 1881, the cession of Montenegro to Greece last November, and the occupation of Tunis by the French.

The amount of information contained in the 380 pages of this admirable class-book is remarkable. And when we state that this is not given in a bald way, but with a fair amount of explanation and in a readable style, we say nothing more than the book merits, but which few books of the same nature and design possess.

The Code Poetical Reader. Crown 8vo, 152 pp. London: Burns and Oates.

This book has been produced by the publishers in capital style. The printing, paper, and binding are faultless. To Mr. Jackson, the editor, high praise is due. His selections are admirable. The neatly arranged marginal notes, explanatory of the text, will be found very helpful. We gladly recommend the book.

Notabilia of English History. Crown 8vo, 64 pp. By W. Blanchard. London: Thomas Murby.

The preface of this book begins—'The grand maxim of learning is to fix the mind on the right things.' Upon looking carefully through these sixty-four pages, we are bound to say that the author has given us a goodly array of 'right things' to store away in the memory. Used side by side with an ordinary text-book, Mr. Blanchard's 'Notabilia' will prove of great assistance to students preparing for historial examination.

The Civil Service Coach. Fcap. 8vo, 208 pp. London: Crosby, Lockwood, and Co.

The title of this volume exactly describes its aims. What the living coach does for his pupil, this book does in a great measure for the student who has to plod his way single-handed. To all who contemplate entering the civil service, and to teachers who coach their boys for the Civil Service Examinations, it will be invaluable.

Glimpses of the Earth. By J. R. Blakiston. Fcap. 8vo, 320 pp. London: Griffith and Farran.

The same excellencies which marked the earlier volumes in this series are apparent in the book now before us. It will form an admirable reader. We are, however, sorry to find that Mr. Blakiston still adheres to his conviction that it is better a reading book—and of all others a *geographical* one—should be sent forth without a single picture to enliven its pages. In spite of this, these pleasant glimpses deserve to be widely read.

Introductory Geographical Reader. Fcap. 8vo, 96 pp. London and Edinburgh: W. and R. Chambers.

This serviceable little manual merits our highest praise. It is a simple, beautifully illustrated, and altogether charming introduction to the study of geography, and will be greatly appreciated by all who use it. When we state that the Messrs. Chambers are the publishers, our readers will know what to expect in the way of 'get-up.'

Harry Hawkins' H Book. London: Griffith and Farran.

We advise all our young friends who have any difficulty with their H's to invest a sixpence in this clever little brochure. It not only affords first-rate exercise in the use of the much-abused H, but if read aloud to a small party, will yield amusement. We question if the author is correct in aspirating the first letter in herb. We were always taught that it was silent.

Morality. Cr. 8vo, 158 pp. By Dr. Hime. London: W. Guest.

We need but say that Dr. Hime, the author of this book, has done his delicate and difficult task well. The perusal of these pages cannot fail to have a beneficial influence on those for whom they are designed. The Doctor has our best wishes in his praiseworthy efforts to raise the moral tone of our youth.

—o—

Scholarship Examination, 1881.

Composition and Grammar.

MALE AND FEMALE CANDIDATES.

Two hours and a half allowed.

(No abbreviation of less than three letters to be used in parsing or analysis.)

Candidates must not answer more than *one* question in each of the Sections IV., V., VI.

Composition.

Write a letter descriptive of—

(1) The early signs of spring;
or, (2) Some museum with which you are acquainted;
or, (3) Some act of kindness or heroism which you may have witnessed;
or, (4) Some of the difficulties of a young teacher's life.

Grammar.

SECTION I.

Parse fully the words italicized in the following sentences (Syntax is an essential part of parsing):—

Yet *live* there *still*, who *can remember* well
How when a mountain-chief his *bugle* blew,
Both field and forest, dingle, *cliff*, and dale,
And solitary heath the *signal* knew;
And *fast* the faithful clan around him *drew*,
What time the warning note *was* keenly *wound*,
What time aloft their *kindred* banner flew,
While clamorous war-pipes yelled the gathering sound,
And while the Fiery Cross glanced, *like* a meteor, *round*.

SECTION II.

Analyze the following sentences, making a table, showing in separate columns—

(1) The nature of the sentence.
(2) (If dependent) its relation to the principal sentence.
(3) Subject.
(4) Its enlargement (if any).
(5) Predicate.
(6) Its extensions (if any).
(7) Object.
(8) Its enlargement (if any).

How to deal with him was a puzzling question.

While the lion and the tiger were tearing each other, the jackal had run off into the jungle with the prey.

Who spills the foremost foeman's life,
His party conquers in the strife.
If I suffer causeless wrong,
Is then my selfish rage so strong,
My sense of public weal so low,
That for mere vengeance on a foe
Those cords of love I should unbind
Which knit my country and my kind?

SECTION III.

Select and classify the pronouns, conjunctions, and adverbs in the sentences given above.

SECTION IV.

1. Write out rules for the spelling of those classes of words which include rec**ei**ving, judg**m**ent, change**a**ble, so far as relates to the part of the word printed in larger type.

2. Explain the terms reflexive, indefinite, and show in what sense they are applied to some of the parts of speech.

3. Explain the term subjunctive mood, and give examples of its uses.

SECTION V.

1. Show that the following words may represent two or more parts of speech—next, under, till, by, that, like.

2. Derive the following words—compact, arrange, acquaint, algebra, geography, dissuade, abroad, precede, suspend.

3. Give a noun, an adjective, and a verb, formed from each of the following Latin words—disco, sedeo, scribo, verto, duco, dico.

SECTION VI.

1. State whether the concords in the following sentences are incorrect, and give the proper rule of concord in each case:—

Neither she nor James were there.
Either Mary or Jane must fetch me their rake.
Scott's 'Tales of a Grandfather' were written for his grandchildren.

2. Explain the terms metaphor, simile, and give appropriate examples.

3. Give examples of defective English verbs, and show how the deficiencies are supplied.

ANSWERS—COMPOSITION AND GRAMMAR.

Composition.

(1.)

The Grange,
Abbotleigh, Co. Devon,
July 10th, 1881.

MY DEAR FRIEND,—The dreary winter, the miserable effects of which we were feeling when last I wrote to you, at length shows signs of disappearing altogether. The days are slowly, but surely lengthening; and although the mornings and evenings are still very cold, the power of the sun is felt during the day. The trees and hedgerows are bursting into leaf, and the grass has lost its withered look, and is now quite green and beautiful. Yesterday I took a walk down the dell, and found the banks literally covered with primroses, while here and there the modest white and purple violets might be seen just peeping above the ground. In the clump of elms behind the Grange the rooks are again to be heard, while the lark and the thrush and the linnet make the air vocal with their melodies. The farmers in the neighbourhood can now commence the sowing for early crops, and every hand is now employed out of doors in ploughing, harrowing, or such-like operations. The coming of spring adds new pleasure to our daily existence, and it needs only your company to make my stay not only endurable, but pleasant. Can you not make it convenient to come? With kindest regards,

I am,
Yours very faithfully,
JEAN PAUL.

(2.)

110, Bridge Street, Burfleet,
Co. Blank,
July 10th, 1881.

MY DEAR SIR,—The Museum of which our town can boast is a source of great pleasure and instruction to thousands of the inhabitants. Since its removal to the new premises, the attendance is even more numerous than before. The Museum stands at the foot of the park, and some of its windows command a most delightful view. Entrance is obtained from one of the main streets of the town into a large hall, at the farther end of which there is a large conservatory, filled with choice native and exotic plants, and enlivened by the songs and voices of many caged birds. The hall is adorned with statues of local celebrities and models of ships and other objects for which our town is famous. Folding doors to the left lead us into a lofty, well-ventilated, well-lighted room, forming the main portion of the Museum. Every available space on the walls is covered with glass cases, and two rows of tables down the centre of the room are also covered in a similar manner. These cases are filled with specimens of different kinds of birds, reptiles, insects, shells, and the lesser animals, while specimens of the larger wild animals occupy vacant spaces on the floor. A spiral staircase leads to a gallery which runs round the whole of the inside of the building, and the walls here are also covered with well-filled cases, or with various curiosities from different parts of the world. The Curator is an affable, well-informed gentleman, and on several occasions has rendered me great service when I have visited the Museum for a special purpose. Few towns are so well provided as Burfleet in this respect, although the spread of education renders such places more useful and more necessary every year.

I am, my dear Sir,
Yours truly,
HUGH OWEN.

(3.)

North Bournemouth,
Co. Northumberland,
July 10th, 1881.

DEAR UNCLE,—Few parts of our country have witnessed more heroic deeds than those which have been enacted on the north-east coast; and even among these, noble as they are, few rank so high as one which I witnessed a short time ago in the county of Northumberland. The gales on this rock-bound coast have often proved fatal to many a gallant bark, and that of November 12th was no exception to the rule. Among other vessels in danger, an Italian sloop was driven ashore. The intensity of the gale and the loss of some of the ship's tackling had rendered her unmanageable, and, as the seamen were unacquainted with the use of the rocket apparatus, there seemed no possibility of saving the lives of those on board. At last a hardy miner, who had on previous occasions displayed remarkable courage in saving life, volunteered to carry the line to the vessel, which was now beating helplessly on the rocks. The people on shore looked upon the attempt as sheer madness, but the sight of a woman clinging to the mast and clutching to her breast a tiny child only increased his determination to try. Binding a stout rope round his waist, he assayed to reach the ship. Time after time he was beaten back, but ultimately succeeded in fastening the apparatus, by means of which the whole of the crew were saved. Every attention was paid to the rescued sailors and passengers, whose position seemed the more deplorable that they were unable to make themselves understood by those about them, while acclamations loud and long-continued greeted the brave-hearted miner for his deed of heroism. Some public recognition of his bravery is to be made, and no worthier recipient of a testimonial could be found.

Believe me yours truly,
HERON HAVELOCK.

(5.)

The Schoolhouse,
Hardcourt,
Near Broadfoot,
July 15th, 1881.

MY DEAR COUSIN,—My apprenticeship has terminated, and I have just been sitting at the Queen's Scholarship Examination. One of the questions rendered it necessary that I should consider what were the difficulties attending a young teacher's life; and as you think of 'joining the ranks,' I will tell you what I believe you may expect. You will find that the leisure you have so frequently had for light reading will be gone. Every day will show you the necessity for increasing your store of knowledge. The work of school will sometimes thoroughly weary you, and there will be great disinclination to hard study. One of your first and one of your most lasting difficulties, unless you are really bent upon being a workman who does not need to be ashamed, will be to overcome the tendency to desultory reading at home.

In school you will find difficulties on account of the different dispositions of your scholars, and when you imagine a certain method of procedure will effect the purpose you have in view you will in the end often be wofully disappointed. You will require to be constantly on the watch to avoid errors in this respect. Another difficulty will be to keep all your boys at work. Your energies may be bent upon one boy, and the class will become disorderly. A teacher has to learn (whatever the old proverb may say) to be able to do two or more things at the same time.

I have also found considerable difficulty in doing my work without causing worry to the master. I had to be unceasing in my efforts to avoid making too much noise, sending bad boys out for punishment as the easiest way of getting rid of them, or myself punishing them against the rules of the school.

These are some of the difficulties which have presented themselves to me, and I dare say you will not be exempt from them either. I have, however, overcome them. Teaching has numerous pleasures, and that they may far outnumber the difficulties you may meet with is the earnest wish of

Your affectionate Cousin,
CHARLES STEPHENS.

To TOM COURTNEY.

Grammar.

SECTION I.

Live—verb, reg. intrans., act., ind. pres., 3rd pl., agreeing with persons.

still—adv. of time, mod. 'live.'

can—verb, aux. to 'remember,' indg. pot. mood, pres.

remember—verb, reg. trans., inf. pres., gov. by 'can.'

can remember—verb, reg. trans., act., pot., pres., 3rd pl., ag. with its nom. 'who.'

how—cop. conj., joining 'who can remember' and 'field, etc., knew.'

bugle—noun, com., neut., sing., 3rd obj. gov. by 'blew.'

both—cop. conjunction, introducing the sent. 'Both field...... knew,' correlative with 'and.'

cliff—noun, com., neut., sing., nom. to 'knew.'

signal—noun, com., neut., sing., obj. gov. by 'knew.'

fast—adverb (manner), qual. 'drew.'

drew—verb, irreg. trans. (used intransly.), act., ind., past, 3rd sing., ag. with 'clan.'

what—relative pronoun used as adjective, qualifying 'time.'

was—verb, aux. to 'wound,' indicating pass. voice.

wound—past participle of 'to wind,' ref. to 'note.'

was wound—verb, irr. trans., pass., ind. past, 3rd sing., ag. with 'note.'

kindred—noun used as adj., qual. 'banner.'

like—adj. governing 'meteor.' *Like* might be considered = as: it would then be a conjunction, joining 'Fiery Cross glanced' and a 'meteor glances.'

round—adv. of place, qual. 'glanced.'

SECTION II.

Kind of Sentence.	Rel. to Principal Sent.	Subject.	Enlargement of Subject.	Predicate.	Extension of Pred.	Object.	Enlargement of Object.
Principal Sent.		[How] to deal	with him	was a puzzling question			
(a) Subordinate Sent.	Adverbial to *b*.	[While] lion and tiger	the	were tearing		each other	
(b) Principal Sent.		jackal	the	had run	off into the jungle with the prey		
(a) Subordinate Sent.	Adjective to *b*.	Who		spills		life	the foremost foeman's
(b) Principal Sent.		party	his	conquers	in the strife		
(a) Subordinate Sent.	Adverbial (condition) to *b*.	[If] I		suffer	so	wrong	causeless
(b) Principal Sent.		rage	my selfish	is strong			
(c) Principal Sent.	Co-ordinate with *b*.	sense	my of public weal	[is] low	so		
(d) Subordinate Sent.	Adverbial (manner, consequence) to *b* and *c*.	[that] I		should unbind		cords	those of love
(e) Subordinate Sent.	Adjective to *d*.	which		knit		country and kind	my

SECTION III.

Pronouns. *Personal:* him, his, I (2), my (4).
Relative: who, which.
Distributive: each other. Each and other are reciprocal pronouns.

Conjunctions. *Copulative:* how, and (2), if, that, while.

Adverbs. *Degree:* so (2).
Place: off.

SECTION IV.

1. Receiving.—Words containing the improper diphthongs *ei* and *ie*. *Rule.*—After *c* write *e*; after any other consonant write *i*. Exceptions: Seize, weird, either, neither, and words containing -feit.

Judgment, Changeable.—These words are among the *exceptions* to the following rules:—

(*a*) When a word ends with silent *e*, the *e* is retained before an affix beginning with a consonant.

(*b*) When a word ends with silent *e*, the *e* is dropped before an affix beginning with a vowel.

Other exceptions:—

To (*a*)—due, true, whole, awe, lodge, abridge, argue, acknowledge, wide, wise.

To (*b*)—The *e* is retained before affixes *able* and *ous* and some words in *ing*, when the *e* is preceded by *c* or *g*.

2. The literal meaning of *reflexive* is *turned backward.* It is used to describe pronouns (myself, thyself, etc.) when, along with the verb, they show that the action comes back upon the doer—the doer of the action, and the person acted upon being the same. Reflexive pronouns are formed by the addition of the noun *self* to the possessive or objective case of the personal pronouns.

When a word is not used in a limited, precise, or certain sense, it is said to be *indefinite*. The word *one* is used indefinitely in grammar for *any* person, and is called an *indefinite pro-*

noun. So are *any*, *some*, and *other*. When these words are used as adjectives, they are also called *indefinite adjectives*.

3. The subjunctive mood includes those forms of the verb by means of which an event is spoken of as a supposition, or as conditional upon some other action or event.

It is generally preceded by one of the conjunctions *if*, *that*, *though*, *unless*, *except*, etc. The indicative mood, however, follows these conjunctions quite as often as the subjunctive.

The *subjunctive* is used—

(*a*) When a supposition is made which is contrary to a known fact, as: 'If he were present (which he is not), I would speak to him.'

(*b*) When a clause expresses a wish contrary to the fact, as: 'I wish that he were away (which he is not).'

(*c*) When a supposition is made with regard to the future: 'If they do come, we shall be ready.'

d) Without a conjunction, as: 'Had I expected this, I would have acted differently.'

SECTION V.

1. *Next*; used as *adjective*:—He came the next day.
   as *preposition*:—She followed next the bride.
   as *adverb*:—Who will go next?

   Under; used as *preposition*:—He fell under the wheels of the cart.
   as *adverb*:—The boat went under.

   Till; used as *preposition*:—He stayed till the break of day.
   as *conjunction*:—The siege was continued till the enemy capitulated.

   By; used as *adverb*:—Stand by.
   as *preposition*:—He walked by the river.

   That; used as *distinguishing adjective*:—That man has been here all day.
   as *conjunction*:—He said that he would succeed.
   as *relative pronoun*:—He is the very man that I want.
   as *compound relative*:—We speak that we do know.

   Like; used as *adjective*:—He shall so come in like manner.
   as *verb*:—The boys like play.
   as *noun*:—We ne'er shall look upon his like again.
   as *adverb*:—He spoke in a like manly way.

2. *Compact*—from *com*, with, and *pango*, I fasten.
   arrange—from *ad*, to, and *ranger* (F.), a rank or row.
   acquaint—from *ac*, to, and *cognitus*, known.
   algebra—from Arabic, *al gabr*.
   geography—from *ge*, the earth, and *grapho*, I write.
   dissuade—from *dis*, against, and *suadeo*, I advise.
   abroad—from Anglo-Saxon *a*, and *brad*.
   precede—from *pre*, before, and *cedo*, I go.
   suspend—from *sub*, under, and *pendo*, I hang.

3.

		Noun.	*Adjective.*	*Verb.*
disco	...	disciple	disciplinary	discipline
sedeo	...	sediment	sedate	preside
scribo	...	scribe	scribbling	ascribe
verto	...	version	versatile	divert
duco	...	duke	ducal	educate
dico	...	diction	dictatory	dictate

SECTION VI.

1. (*a*) Incorrect. *Rule.*—Two or more singular nominatives joined by *or* or *nor* require the verb to be in the singular. Neither she nor James was there.

   (*b*) Incorrect. *Rule.*—A pronoun must agree with the noun for which it stands, in gender, number, and person. Either Mary or Jane must fetch me her rake.

   (*c*) Incorrect. *Rule.*—The verb agrees with its nominative in number and person. 'Tales of a Grandfather' is the plural title of a *single* work, and therefore requires the verb to be in the singular.

2. Metaphor is a transferring to one object the sense of another, as—

   The name of the Lord is a strong tower.
   Brevity is the soul of wit.

Simile is a figure by which we express a comparison founded on resemblance. It is generally introduced by the words *like* or *as*.

Ex.—Charity, like the sun, brightens every object on which it shines.

3. The English defective verbs in common use are *shall*, *will*, *may*, *must*, *can*, *ought*.

The following verbs are obsolete, or nearly so. *To wit:—quoth*, *thinks* (= seems), *worth* (*is* or *be*), *durst*, *wont* (now only used as participle), *yclept*. As these verbs make no complete sense by themselves, with the exception of ought, they are used as auxiliaries to other verbs. Each of them is used with the infinitive without the sign *to*.

Languages.

MALE AND FEMALE CANDIDATES.

Three hours allowed for this Paper.

This paper is voluntary.

Candidates examined in England, and *Female* Candidates in Scotland, may answer questions in *one* Language (*only*).

Male Candidates in *Scotland* may answer questions in *two* (not more) Languages.

Latin.

1. Translate into English :—

Hi neque vultum fingere neque interdum lacrimas tenere poterant: abditi in tabernaculis aut suum fatum querebantur, aut cum familiaribus suis commune periculum miserabantur. Vulgò totis castris testamenta obsignabantur. Horum vocibus ac timore paulatim etiam ii qui magnum in castris usum habebant, milites centurionesque, quique equitatui praeerant, perturbabantur. Qui se ex his minùs timidos existimari volebant, non se hostem vereri, sed angustias itineris et magnitudinem silvarum, quae inter eos atque Ariovistum intercederent, aut rem frumentariam, ut satis commodè supportari posset, timere dicebant. Nonnulli etiam Caesari renuntiabant, quum castra moveri ac signa ferri jussisset, non fore dicto audientes milites, neque propter timorem signa laturos.

2. Parse fully the words querebantur, castris, equitatui, timidos, intercederent, fore, jussisset, laturos.

3. (*a*) Decline in both numbers, ille ferox miles and leo iste fulvus.

   (*b*) Give the dative singular and plural of flos, filia, arbiter, eques, dux, senectus. domus, dies, portus, genu, and filius.

   (*c*) Give the perfect of scribo, cano, adsum, facio, possum, sono, vivo, soleo, rapio, capio, peto, cedo, lego, and conjugate, in the passive form, facio, interficio, and satisfacio.

4. Explain the subjunctives in the passage given above.

5. Translate into Latin :—

   (*a*) There were some, who could not restrain their tears.
   (*b*) He is not the man to complain of his fate.
   (*c*) No brave man fears the enemy.
   (*d*) I cannot deny that he is a brave man.
   (*e*) No one is allowed to break the laws.
   (*f*) Who taught you music and grammar?
   (*g*) We have need of peace.

6. Translate into Latin :—

When the news had been brought to Caesar that they are endeavouring to make their way through our province, he set out from the camp. When the Helvetii were informed of his approach, they send ambassadors to him, to say that they propose to march through the province, as they have no other way.

Greek.

1. Translate into English :—

'Εγὼ μὲν γὰρ ὀκνοίην ἂν εἰς τὰ πλοῖα ἐμβαίνειν ἃ ἡμῖν δοίη, μὴ ἡμᾶς αὐταῖς ταῖς τριήρεσι καταδύσῃ· φοβοίμην δ' ἂν τῷ ἡγεμόνι ᾧ δοίη ἕπεσθαι, μὴ ἡμᾶς ἀγάγῃ ὅθεν οὐχ οἷόν τε ἔσται ἐξελθεῖν· βουλοίμην δ' ἂν, ἄκοντος ἀπιὼν Κύρου, λαθεῖν αὐτὸν ἀπελθών· ὃ οὐ δυνατόν ἐστιν. 'Αλλ' ἔγωγε φημὶ ταῦτα μὲν φλυαρίας εἶναι· δοκεῖ δέ μοι ἄνδρας ἐλθόντας πρὸς Κῦρον, οἵτινες ἐπιτήδειοι, σὺν Κλεάρχῳ ἐρωτᾶν ἐκεῖνον τί βούλεται ἡμῖν χρῆσθαι· καὶ ἐὰν μὲν ἡ πρᾶξις ᾖ παραπλησία οἵαπερ καὶ πρόσθεν ἐχρῆτο τοῖς ξένοις, ἕπεσθαι καὶ ἡμᾶς καὶ μὴ κακίους εἶναι τῶν πρόσθεν τούτῳ συναναβάντων·

2. Parse fully *δοίη, καταδύσῃ, ᾧ, ἀγάγῃ, ἄκοντος, φλυαρίας, ἡμῖν, κακίους, ἐχρῆτο, συναναβάντων.*

3. (*a*) Decline in both numbers *αὕτη ἡ χώρα*, and *οὗτος, αὕτη, τοῦτο.*

(*b*) Give the genitive singular of *χώρα, στρατιώτης, πέδιον, ἀνηρ, μισθοδότης, πατὴρ, δύναμις, χειρ, πάθος*, and the genitive dual and plural, respectively, of *ἐπιστολὴ, ἄγγελος*, and *βασιλεύς*.

(*c*) Give the aorists of *ἐλαύνω, πέμπω, μένω, φεύγω, ἔχω, επαινέω, ἔρχομαι, τέμνω, τίθημι, ἵημι* and *δίδωμι.*

4. State what you know of the rules for the comparison of adverbs, and compare *σοφῶς*; *αἰσχρῶς, ἄνω, κάτω, εὖ, ἐγγὺς, μάλα, πολὺ* and *πρωΐ.*

5. Translate into Greek :—

(*a*) Cyrus collected an army and besieged the city.
(*b*) Cyrus stayed there five days.
(*c*) Be not astonished that I am sorely troubled at the present state of things.
(*d*) It seems to me that it is not the time for us to sleep.
(*e*) They said they would not go.
(*f*) Be well assured that I would choose freedom.
(*g*) Do you think that the king will fight with you?

ANSWERS—LANGUAGES.

Latin.

1. Now and then these men were unable either to control their countenance or restrain their tears. They bewailed their fate in the seclusion of their tents, or deprecated the common danger in the company of their comrades. Wills were being signed everywhere all over the camp. Gradually even those who had had great experience in military service, the soldiers, and centurions who were at the head of the cavalry, were disturbed by the talk and the terror of these men. Those of these who wished to be considered less timid, kept asserting that it was not the enemy they feared, but the difficulties of the journey and the size of the woods which lay between them and Ariovistus, or that the commissariat could scarcely be conveniently maintained. Some even announced to Caesar, when he had ordered the camp to be struck and the standards to be raised, that through their dread the soldiers would be disobedient to his command and would refuse to do so.

(It will be noted that we have not translated '*timere.*' Caesar uses this word because *vereri* cannot be applied to things. The difference is untranslatable.)

2. *Querebantur*—deponent verb., indicative, imperf., 3rd plu. *queror, questus sum, queri.*
castris—noun, 2nd declension, neuter, abl. plural.
castrum means a 'fort.'
castra ,, 'camp.'
equitatui—noun, 4th declension, masculine, dative singular from *equitatus*.
timidos—adj. masc. acc. plural, from *timidus—a—um.*
intercederent—verb, 3rd conj., imperf. subj., 3rd plural, from *intercedo, intercessi, intercessum.*
fore—verb, future infin., *sum, fui, esse.*
jussisset—verb, 2nd conj. act., plu. perf. subj., 3rd plural —*jubeo, jussi, jussum.*
laturos—verb, future, participle, act., accusative masc., plural—*fero, tuli, latum, ferre.*

3.

		Singular.	Plural.
(*a*)	*N.*	ille ferox miles	illi feroces milites
	G.	illius ferocis militis	illorum ferocium militum
	D.	illi feroci militi	illis ferocibus militibus
	Ac.	illum ferocem militem	illos feroces milites
	Ab.	illo feroce milite	illis ferocibus militibus
	N.	leo iste fulvus	leones isti fulvi
	G.	leonis istius fulvi	leonum istorum fulvorum
	D.	leoni isti fulvo	leonibus istis fulvis
	Ac.	leonem istum fulvum	leones istos fulvos
	Ab.	leone isto fulvo	leonibus istis fulvis

(*b*) Dat. sing.	flori	plur. floribus
	filiae	filiabus
	arbitro	arbitris
	equiti	equitibus
	duci	ducibus
	senectuti	senectutibus
	domui { locative domi	domibus
	diei	diebus
	portui	portubus
	genui	{ genubus genibus
	filio	filiis

(*c*)	scribo	perf.	scripsi
	cano	,,	cecini
	adsum	,,	adfui
	facio	,,	feci
	possum	,,	potui
	sono	,,	sonui
	vivo	,,	vixi
	soleo	,,	solitus sum
	rapio	,,	rapui
	capio	,,	cepi
	peto	,,	petii
	cedo	,,	cessi
	lego	,,	legi

(The latter part of the present question may be found in any Latin grammar. So far as we see, 'conjugate' means give all the tenses in full.)

4. The first subjunctive is intercederent. This is naturally subjunctive as occurring in a sentence dependent upon a sentence which is itself in oratio obliqua. Here of course the writer has no motive, such as a wish to emphasise the *fact* that there were angustiae itinerum, sufficient to induce him to use the indicative.

posset is subjunctive after ut with a verb of fearing, corresponding to our *lest . . . . not.*
jussisset. The usual construction with *quum* in oblique narration of past time is the plu. perf. subj.

5. (*a*) Erant qui lacrimas tenere non possent.
(*b*) Non is est qui fata miseretur.
(*c*) Nemo fortis hostem veretur.
(*d*) Negare non possum quin fortis sit.
(*e*) Nemini licet leges violare.
(*f*) Quis te musicam atque grammaticam docuit?
(*g*) Opus est nobis pacis.

6. Quum Caesar certior factus esset eos ut iter per provinciam facerent eniti, e castris profectus est. Helvetii adventu nuntiato legatos ad eum mittunt qui dicerent se per provinciam quum via nulla alia pateret, ituros esse.

Greek.

1. For I on the one hand should shrink from embarking in the boats which he would provide for us lest he should sink us, triremes and all. On the other hand I should fear to follow the leader he would give us lest he should lead us to a place whence we could not return. And if I were to go away without the consent of Cyrus, I should wish to escape his notice in so doing. This is impossible. But at least say that such talk is nonsense. My opinion is that men, whosoever are fit, should go to Cyrus along with Klearchus and ask him for what purpose he intends to use us. If the business should resemble that for which he formerly used the allied troops, we also should follow and not be more cowardly than those who previously went up with him.

2. *δοίη*—Third person singular, strong aorist optative, active of *δίδωμι, δώσω, ἔδωκα.*
καταδύσῃ—Third person singular, weak aorist, subjunctive active of *καταδύω—δύσω, κατεδύσα.*
ᾧ—Dative singular masculine of *ὅς, ἥ, ὅ.* In this case it is dative through *attraction* instead of the more natural accusative *ὅν.*
ἀγάγῃ—Third person singular, strong aorist subjunctive, active of *ἄγω, ἄξω, ἀγήοχα* or *ἦχα, ἤγαγον.*
ἄκοντος—Genitive masculine singular of *ἄκων, ἄκουσα, ἄκον.*
φλυαρίας—I. Declension. Accusative plural of *φλυαρία, φλυαρίας.*
ἡμῖν—Dative of *ἡμεῖς*, which is used as the plural of *ἐγὼ.*
κακίους—Accusative plural masculine of *κακίων*, the comparative of *κάκος.*
ἐχρῆτο—Third person singular, imperfect indicative of *χράομαι.*
συναναβάντων—Genitive plural masculine of the strong aorist participle active of *συναναβαίνω, βήσομαι, βέβηκα, συνάνεβην.*

3. (*a*)

		Sing.	
N.	*αὕτη*	*ἡ*	*χώρᾱ*
G.	*ταύτης*	*τῆς*	*χώρας*
D.	*ταύτῃ*	*τῃ*	*χώρα*
A.	*ταύτην*	*την*	*χώρᾱν*
		Dual.	
N.A.	*τάυτα*	{ *τὰ* or *τὼ*	*χωρᾱ*
G.D.	*τάυταιν*	*ταῖν*	*χωραῖν*

	Plur.		
N.	αὗται	αἱ	χῶραι
G.	ταύτων	τῶν	χωρῶν
D.	ταύταις	ταῖς	χώραις
A.	ταύτας	τὰς	χώρας

	Masc.	Fem.	Neut.
N.	οὗτος	αὕτη	τοῦτο
G.	τούτου	ταύτης	τούτου
D.	τούτῳ	ταύτῃ	τούτῳ
A.	τοῦτον	ταύτην	τοῦτο
N.A.	τούτω	{ τούτω or ταύτα	τούτω
G.D.	τούτοιν	ταύταιν	τούτοιν
N.	οὗτοι	αὗται	ταῦτα
G.	τούτων	τούτων	τούτων
D.	τούτοις	ταύταις	τούτοις
A.	τούτους	ταύτας	ταῦτα

(*b*) Gen. sing. of

χώρα	χώρας
στρατιώτης	στρατιώτου
πεδίον	πεδίου
ἀνήρ	ἀνδρός
μισθοδότης	μισθοδότου
πατήρ	πατρός
δύναμις	δυνάμεως
χείρ	χειρός
πάθος	πάθους

4. Gen. dual and plur. of

ἐπιστολή,	ἐπιστολαῖν,	ἐπιστολῶν
ἄγγελος,	ἀγγέλοιν,	ἀγγέλων
βασιλεύς,	βασιλέοιν,	βασιλέων

(*c*)

ἐλαύνω	ἤλασα
πέμπω	ἔπεμψα
μένω	ἔμεινα
φεύγω	ἔφυγον
ἔχω	ἔσχον
ἐπαινέω	ἐπῄνεσα
ἔρχομαι	ἦλθον
τέμνω	ἔταμον } ἔτεμον
τίθημι	ἔθηκα
ἵημι	ἧκα
δίδωμι	ἔδωκα

4. We have two chief cases :—

I. When the comparative and superlative are adjectives,

as	πρό	προτέρος	πρῶτος
	ὑπο	ὕστερος	ἕσχατος

II. When the comparative and superlative are adverbs. Theseare again subdivided :—

A. Following analogy of their adjectives—for the comparative take the neuter singular of the adjectival comparative; for the superlative, the neuter plural of the adjectival superlative.

σόφως	σοφώτερον	σοφωτάτον
αἰσχρως	αἴσχιον	αἴσχιστα
μαλὰ	μαλλὸν	μάλιστα
πολὺ	πλεῖον } πλέον	πλεῖστα
πρωΐ	πρωιτέρον	

B. Adverbs with comparative in—σερω by the side of one in—τερον, or in—ονως by the side of—ον. The superlative in—τατως not used.

σαφῶς	{ σαφεστέρως σαφεστέρον	σαφεστάτα
εὖ	ἄμεινον	ἄριστα
	{ κρεισσονῶς κρεισσὸν	κρατιστὰ
	βελτίον	βέλτιστα

C. Comparative and superlative in—τερω—τατω.

ἄνω	ἀνωτέρω	ἀνωτάτω
κατω	κατωτέρω	κατωτάτω
ἐγγυς	{ ἐγγυτέρω ἐγγυτέρον ἐγγίον	{ ἐγγυτάτω ἐγγυτάτα ἔγγιστα

5. (*a*) ὁ δὲ Κύρος στρατευμὰ ἀθροισας τὴν πόλιν ἐπολιορκήσεν.
(*b*) ὁ δὲ Κύρος ἄντου ἔμεινε πέντε ἥμερας.
(*c*) μὴ θαυμασῇς εἰ ἄυς φέροιμι τὰ παρόντα.
(*d*) ἔμοι δοκεῖ οὐ τούτον τὸν κάιρον ἡμῖν κάθευδειν.
(*e*) οὐκ ἔφασας μέλλειν ἀπιεναι.
(*f*) εὖ ἴσθι ἔμε ὡς τὴν ἐλευθερίαν αἱρησομένον.
(*g*) ἆρα δοκεῖ ὅτι ὁ βάσιλευς πρὸς ὑμας μαχέσεται ;

[In consequence of the pressure upon our space, we are compelled to hold over the remainder of these Questions till next month.]

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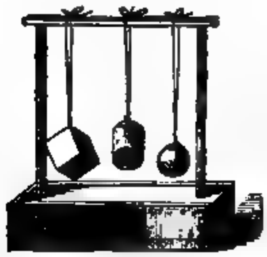

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adopted for warming and also for lighting the school, and managers who neglect this rule will fail in at least two of the points mentioned, if not in all three. Open windows can be tolerated in hot weather, but they will not be endured in cold seasons. Hence it is necessary to take into consideration the principle which is to be adopted for warming the building when the plans for building schools are decided upon. It is customary to leave these questions to be settled after the school has been built. But, in reality, lighting and warming must be a part and parcel of the principle adopted for ventilating a school. Open fireplaces are unsatisfactory in large schoolrooms. Those children who are seated near to the fireplace are scorched, whilst those farthest away do not get a ray of warmth. Their places are fixed for them, and there is no probability of change. For reasons, such as economy and efficient supervision, it is best not to increase the floor space to too large an area, but overcrowding greatly increases the difficulty as to ventilation, and the space permitted by the Privy Council is most unsatisfactory on the point of health. A school which is full cannot be provided with air containing at all times less than ·6 per 1,000 of Co_2 by any system of ventilation, unless in connection with artificial means for moving the air. An hour after assembly, the Co_2 will be found to have risen to 1 vol. per 1,000, and, as a consequence, the children become heavy and listless, and unable to attend properly to the instructions of the teacher. The floor space for each pupil should not be less than nine feet, whatever the cubical contents of the room may happen to be; and this is too little unless the very best principles of ventilation are adopted. Twelve square feet will be more satisfactory. The windows may be used for outlets; they are very efficient for this purpose. They should be arranged so that air may always get out when the school is in work. They should only be used for inlets when the air out of doors is above fifty degrees. In cold seasons the air which is admitted should be warmed air, and warmed without depriving it of its vital principle. It should not be warmed by contact with flame or hot iron. Air which has passed through heated flues is impure air. It has been deprived of its beneficial properties before admission into the room, and is worse than even the admission of cold air would be. Cold air is more preferable to the air which has been warmed in the usual way by red hot iron or gas. Closed stoves and stove pipes, unless they are properly constructed, are all bad means for warming purposes; and gas jets, when the products of combustion are not removed, are worse than all. The most dangerous forms of warming apparatus are those gas stoves which are supposed not to require any communication by stove pipe with the outer air. Gas may be used for warming purposes, and, if the fittings be well designed, it will be found the cheapest and most efficient means for warming a schoolroom; but then all the products of combustion must be carried directly out of the room, and the warmed air which is admitted must not come into contact with the gas flame. The best principle is a combination of Tobin's tubes, which shall enclose a set of minute Bunsen's burners, these burners fitted to the bottom of the tube, but able to obtain the air for their own purposes from the schoolroom. This air must be, after use, then conveyed through a smaller tube containing pieces of asbestos directly out of doors, and no part of it should find its way into the schoolroom. The pipe conveying the products of combustion into the outer air should be enclosed in the Tobin's tube, which brings fresh air into the room from without, and warming it on its progress up the tube. The warmed air may be diffused at as many corners or recesses in the room into which the pipes can be fitted. They should open about three feet from the floor. The area of these tubes should not be less than eight inches in diameter. The Bunsen burners must be arranged so that they cannot be tampered with. It may be convenient to have them fixed in the basement out of sight and reach (where there is a basement); but then the air required for combustion is not taken from the floor of the schoolroom. Four sets of small Bunsen burners, each set of which will consume four feet of gas per hour, will be sufficient to warm the air of a schoolroom sufficiently for 100 children. About 100 feet of gas per day is ample for the purpose, lighting them one hour before the children assemble, there need be no expense for coal, and if gas should be supplied, as it easily ought to be in most places, at 2s. 6d. or 3s. per 1000, it will be a far cheaper and cleaner way of warming and ventilating a school or class-room than by fires, furnaces, chimneys, or water pipes. The apparatus is simple, and if out of order can be easily put right by any gas-fitter. There should be an inlet for fresh air of eight square inches for each twenty children, and in close proximity to some of the inlets there ought to be a small pan containing a little water. The warmed air in passing over this would take up the necessary moisture and prevent the irritating effect which dried air has upon some mucous membranes. The exits for foul air should be larger than the entrances. The sashes of the windows may be so arranged as to allow a constant stream of air to pass out of the room. This is easily managed by having a plate of perforated zinc, or even canvas, stretched across the top of the frame. Canvas keeps out the dirt and blacks, whilst the minute openings prevent draughts, if perchance the passage of air should be in the reverse direction. I have sometimes arranged a Boyle's ventilator in the ceiling with gas jets at its base to compel up draught. The general difficulty is, that outlets of this kind are not large enough for the purpose. Watson's syphon system is a good one when skilfully applied, but it requires an intelligent appreciation of its qualities, and a determination not to allow its principle to be tampered with; otherwise it fails to effect its purpose. On the whole, I prefer Bunsen's burners for promoting the movement of fresh air, when the air outside is too cold for admission without warming. The same channel promotes ventilation when the burners are not in use, and Boyle's ventilators in the roof are the best means for getting rid of bad air when open windows cannot be used. They should always be in addition to the open windows, so that the latter may be closed when the outer air is twenty degrees below the temperature of that inside. From what I have said, it is manifest that no schoolroom is furnished which has not at least two thermometers upon its walls, so placed as to indicate the mean temperature. There should also be placed within view of the teacher a thermometer outside one of the windows, which should be occasionally consulted, so that the temperature of the room may be properly regulated; and it should be a positive rule that at the end of every hour or hour and a half the school or class-room should be emptied for ten minutes at least and the windows thrown wide open, so that all foul air may be thoroughly removed in the middle of the attendance.

Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

Joint Author of 'The Field Naturalist's Handbook.'

No. VI.—THE COLEOPTERA, OR BEETLES.

PART III.

THE STERNOXI comprise the long, narrow beetles, popularly known as 'Skip-jacks,' a title derived from their curious method of regaining their feet if they should happen to fall upside down upon a level surface. The legs being very short in proportion to the size of the beetle, the insect is unable to regain its foothold in the ordinary manner, but does so in a very remarkable way.

Lying perfectly still for a second or two, as though to summon up all its energies, a sudden 'click' is heard, and the beetle flies for two or three inches into the air, turning half round as it falls, and usually alighting upon its feet. Should it be unsuccessful, as sometimes happens, a second attempt is made, and so on until success crowns its efforts.

A glance at the structure of the thorax will give us a clue to this curious habit.

The *prosternum*, or under side of the prothorax, is produced into a kind of spike (scientifically termed the *mucro*, or dagger), which, when the insect is at rest, fits into a groove between the second pair of legs. When the insect falls upon its back, and wishes to regain its feet, it arches its body into the air in such a manner that it rests only upon the head and the tip of the elytra. While making this movement, the mucro is mechanically drawn from its sheath. With a sudden jerk the position is reversed, and the mucro flies back into its place, forcing the base of the elytra sharply against the ground, and so driving the insect into the air. The word 'Sternoxi' (*i.e.*, sharp-breasted) refers to this structure.

Whilst the beetle is in the act of leaping, the antennæ lie in grooves on the under side of the head, and are so protected from the risk of injury by the fall. In one family, the *Buprestidæ*, this power of leaping is not present.

The beetles of this group are only too abundant, their larvæ being the well-known 'wire-worms,' which are so terrible a pest to the agriculturist. They are long, thin creatures, generally of a yellowish-brown colour, and so tough-skinned that it is almost impossible to damage them, a stamp from a heavy boot merely forcing them into the soil, without causing them the slightest injury.

These wire-worms confine their ravages to the roots of various crops, but, being hidden from sight, cause infinitely more damage than the creatures which feed upon the more exposed portions of the crops. As far as is at present known, no plan seems to succeed in destroying them, and were it not for their natural enemies, viz., the mole, and various birds, the wire-worms would render agriculture an almost total impossibility.

The perfect insects may be found in great numbers during the early part of summer, resting upon leaves and flowers, or flying slowly and clumsily through the air.

The next of the principal groups of beetles consists of the MALACODERMI, or 'soft-skinned' beetles. These comprise the well-known 'Soldiers and Sailors,' the Glow-worm, and many others.

The glow-worm (*Lampyris noctiluca*) deserves more than a mere passing mention.

This insect is well known in almost every part of the country, the pale greenish light emitted by the insect being familiar to even the most unobservant. If the female glow-worm be examined, it will scarcely be taken for one of the beetles, so different is it from those with which we are ordinarily acquainted, possessing neither wings nor elytra, and reminding one far more of a grub than a perfect insect.

Ninety-nine out of every hundred glow-worms met with by the casual observer, however, are females, the males being seldom or never seen except by practical entomologists. The two sexes are strangely dissimilar in appearance, and few would imagine the handsome winged male and the grub-like female to belong to the same species.

Both are luminous, the female in a far greater degree than the male, whose lamp is dim and comparatively insignificant. The light proceeds from the under surface of the three terminal segments of the abdomen. It varies considerably in intensity, being under the control of the insect, which can increase or diminish it at will.

No observer has as yet satisfactorily determined either the cause or the object of this curious property. As far as the former is concerned, very little is known, although many theories have been advanced upon the subject.

As regards the latter, the usual notion is that the light is intended to act as a guide to the male. At first sight this seems plausible enough, but there are several facts which militate against the idea. In the first place, it seems strange that certain night-flying insects should be gifted in such a manner, while others are passed over. Again, if the light of the female be intended to attract her mate, of what use is the luminosity of the male?

Moreover, the larvæ and pupæ are also luminous, as are even the eggs in a slight degree. In these preliminary stages of development, of course, the attraction theory cannot hold good, and we are again at a loss to account for the true object of the light.

The glow-worm is one of the many unrecognised benefactors of the human race, the larva preying largely upon snails, which are destroyed by these creatures in great numbers. At the extremity of the body of the larva is seen a brush-like structure, which is utilized for the double purpose of aiding locomotion, and for cleansing the body from the slime of the snails which have fallen victims to their insatiable foe.

These larvæ may be commonly found both in the autumn and again in early spring, closely resembling the perfect female in general appearance. Towards the middle of May they change to the pupal condition, appearing in the perfect state in the course of two or three weeks.

The TEREDILIA, or Borers, include the little beetles, popularly known as Death-watches, concerning which so many superstitions are still rife amongst the uneducated classes. One of the most abundant of these is the little insect bearing the scientific title of *Anobium striatum*, which is usually the destructive agent in 'worm-eaten' furniture. The peculiar 'ticking' sound, generally considered as the premonition of approaching death to some inmate of the house, is caused by the insect striking its head against the woodwork of the room, as a call to its mate.

The title of HETEROMERA, a word signifying 'unequal jointed,' has been applied to the succeeding group of beetles on account of the structure of the *tarsi*, those of the first and second pairs of legs possessing the full number of five joints, while only four are visible in those of the hinder limbs, the missing joint being merged into the basal one, and so escaping observation. There are also various minor characteristics which it is needless to mention in a series of elementary papers such as the present.

Although the *Heteromera* include a considerable number of insects, the greater proportion are only known to practical entomologists, who have made the coleoptera their especial study. One or two beetles, however, included in the group are familiar to most of those who take even a superficial interest in natural history.

One of these is the common Oil Beetle (*Melöe proscarabæus*), which is plentiful enough in the early spring, and may be seen slowly crawling on the hedge-banks bordering the roadsides. The earlier stages of the oil beetle are very remarkable.

The eggs are laid by the parent beetle in the ground, the young grubs, when newly hatched, being very minute, and furnished with six strangely long legs. Immediately after leaving the eggs, these larvæ find their way to the surface of the ground, and make for the nearest flowers, ascending the stems, and concealing themselves among the blossoms.

Before very long a bee comes in search of honey, and the young grubs leave their retreats, and transfer themselves to the body of the visitor, who unconsciously carries them off to her nest.

Several hundreds of these creatures will sometimes attach themselves to a single humble bee, covering the whole of its body and limbs, and almost disguising its shape. Once in the nest the *Melöe* larvæ quit their bearer, and remain in the interior, feeding upon the stores which had been laid up by the bee for the future young

In its perfect state, the oil beetle is chiefly remarkable for the yellowish fluid which it exudes from the joints of the limbs if handled, and which, in olden times, was considered as a specific for toothache.

The Meal-worm (*Tenebrio molitor*), the larvæ of which are in such request among bird-fanciers as food for their pets, also belongs to this group.

We now come to the enormous group of RHYNCHOPHORA, or Weevils, which may be distinguished by the formation of the head, which is prolonged into a kind of beak, or *rostrum*. The word 'rhynchophora' (*i.e.*, 'snout-bearers') refers to this structure. In the greater number of species the antennæ are elbowed.

In this country, the weevils number some five hundred species, mostly of small size, averaging, perhaps, the sixth of an inch in length. Abroad, however, and more especially in tropical countries, their numbers are very considerably augmented, and they attain to far greater dimensions than is the case with our own species. Some of the forms, too, are especially striking.

Amongst the weevils are included many which must be ranked among the direct enemies of man, their ravages causing the annual loss of many thousands of pounds of money. The most terrible of these, perhaps, are the two Corn Weevils (*Calandra granaria* and *oryzæ*), which cause almost immeasurable damage in granaries, both of British and foreign grain. They are both small insects, barely one-eighth of an inch in length. The first-named is of an uniform dark brown hue, and is rather the larger of the two; the ground colour of the latter is also brown, the elytra being ornamented with four red spots. Neither of them are supposed to be indigenous to Britain, but are thought to have been accidentally introduced from abroad.

The destruction caused by these two tiny insects is almost beyond belief. We read that they are 'screened,' or sifted, from the corn literally by the ton, and when we consider the quantity of grain which must have been devoured by these insects before they attained to their perfect state, we can easily imagine the terrible havoc which they cause.

The corn weevils are most prolific insects, and it is said that the progeny of a single couple will amount to as many as six thousand beetles in the course of a single year. The eggs are deposited singly by the parent insect, one in each grain of corn, the interior of which is entirely hollowed out by the larva, the mere shell only remaining untouched. When full-fed, it changes to the pupal condition within the grain of corn upon which it has been feeding, remaining therein until it reaches the perfect state.

Owing to the difficulty of separating the damaged corn from that which is unhurt, it is by no means easy to put a limit to the ravages of these insects, and the only method of doing so would appear to be by destroying the whole of the weevilled grain by means of fire. In the course of a few years their numbers would naturally be considerably diminished, and we might hope, in time, to see the almost total extinction of these destructive little pests.

A very well-known beetle of this group is the Nut Weevil (*Balaninus nucum*), with which most of my readers have probably, at some time or other, been acquainted in a manner the reverse of pleasant. Most people know the disgusting flavour of a 'bad' nut, in which a nauseous dust has taken the place of the sweet kernel.

This unpleasant transformation is owing to the nut weevil, which introduced an egg into the fruit while it was yet soft, the young larva devouring the kernel, and filling the shell instead with its bitter black frass. When full-fed, the grub gnaws its way through the shell, leaving a small round hole as the only indication of its ravages, and falls to the ground, where it undergoes the remaining phases of its development.

A similar insect attacks cork, and is the cause of the nauseous flavour in 'corked' wine.

The insect itself is a roundish creature, of a dark reddish-brown colour, prettily mottled with black and white markings. The beak is peculiarly long and slender, and is curved downwards from about the middle. It is slightly larger than the generality of weevils, being rather more than a quarter of an inch in length.

The most destructive of our British wood-boring beetles is the little insect known as *Scolytus destructor*, both of which titles are singularly appropriate, the former signifying a winding passage, and referring to the tunnels bored by the beetle, while the application of the second is evident enough.

Elm-trees are the chief sufferers from the ravages of this beetle, which drives its tunnels in every direction, forming a perfect network of sub-cortical passages, and finally entirely stripping the lower part of the tree of its bark. It is far from unusual to see a tree entirely denuded of bark to the height of some eight or

nine feet from the ground, while the wood is completely covered with the burrows of the *Scolytus*.

Next we come to the LONGICORNES, or Long-horned Beetles, so called from the length of their antennæ, which are almost invariably thread-like, and are never clubbed at the tips.

The larvæ of the longicornes being wood-borers, the beetles are, of course, more or less destructive, although, owing to their comparative scarcity, we do not suffer very greatly, in this country, from their attacks. Residents in the tropics, however, might tell a different tale, for in equatorial countries the longicornes increase to a wonderful degree, both in numbers and size.

The two best known of our British longicornes are undoubtedly the Musk and the Wasp Beetles.

The former of these (*Cerambyx*, or *Aromia, moschata*) is usually common in the neighbourhood of willow-trees, upon the wood of which the larva feeds. It is rather a large insect, being generally about an inch and a quarter in length, exclusive of the antennæ, and is of a bright metallic hue, either green or brassy.

Its chief peculiarity lies in the powerful musky odour which proceeds from the body, and which is produced, although in a lesser degree, by several other beetles, of which the well-known Tiger Beetle is one. So powerful is this odour, that the presence of the beetle can be detected at a distance of several yards. If the insect is handled, too, the scent clings about the fingers for some little time.

The musk beetle also possesses the power of producing an audible sound, by the friction of the harder parts of the body against each other. The sound is short, sharp, and shrill, and is repeated in rapid succession, sufficiently loudly to be audible at some little distance.

The Wasp Beetle (*Clytus arietis*), although not more common than the Musk, is, as a rule, far more often noticed, its bright colours and active movements, so diametrically opposed to the sluggish habits of the latter insect, rendering it a very conspicuous object.

It is a handsome insect, and well deserves its popular title, the black and yellow elytra bearing a strong resemblance to the markings of the insect from which it derives its name.

The last but one of the groups of the coleoptera, viz., the PHYTOPHAGA, or 'plant-eaters,' comprises some of the most beautiful of all the British beetles. To this group belong the Chrysomelas (*i.e.*, 'golden apples'), whose polished forms look like so many shining gems; the exquisite Donacias, whose metallic bodies stud the stems of the water plants, and many others of equal beauty.

One of the most familiar *Phytophaga* is the well-known Asparagus Beetle (*Crioceris asparagi*), with its crimson thorax, and yellow and black elytra, which is so common upon the plant after which it is named, and which is so cordially detested owing to the mischief it causes. The Bloody-nose Beetles (*Timarcha*) too, with their curious habit of exuding a drop of reddish fluid from the mouth if handled; and the *Halticidæ*, those tiny little beetles with so wonderful a power of leaping, also belong to this group.

The last group consists of the PSEUDOTRIMERA, or insects with 'false three-jointed' *tarsi*, so called because the tarsi are formed of four joints, whereas they only appear to possess three.

With a few exceptions, the beetles of this group are popularly known as Lady-birds (*Coccinellidæ*), insects which are more valuable to us than most of us have any idea of. But for the lady-birds, our hop-grounds would be ruined, and we should scarcely be able to keep a fruit-tree in our orchards, or a flower in our gardens. For the devouring aphis, or 'blight,' as we often term it, would be master of the situation, and would pursue its destructive course unchecked by the attacks of the ravenous lady-birds, which, both in the larval and perfect states, destroy them in myriads, and keep their numbers within proper limits.

There are several species of lady-birds inhabiting Great Britain, some of which are exceedingly common, while others are correspondingly rare. Our two commonest species, *Coccinella bipunctata*, popularly known as the 'two-spot,' and *C. variabilis*, vary in colour and markings to an almost inconceivable degree—so much so, in fact, that a drawer might almost be filled with specimens of these beetles alone, no two of which should exactly resemble one another.

In some years these beetles are far more plentiful than in others, and it will be generally found that, when the aphides are unusually numerous, there is a corresponding increase in the numbers of the lady-birds, which serve to keep down the ravages of the destructive little creatures.

The next paper of this series will be devoted to a description of the *Euplexoptera*, or Earwigs, and the *Orthoptera*, comprising the Cockroaches, Grasshoppers, etc.

(To be continued.)

Anecdotal Natural History.

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No. VIII.—THE DOG TRIBE.

UPON examining the respective skeletons of one of the cats and of a member of the dog family, we shall see that the distinctions are very apparent. The form of the cat is evidently that of an animal which is intended to creep up stealthily to its intended victim, and then to despatch it by means of a single bound. Almost every detail of the cat tells the same story; the structure of the skeleton, the pads beneath the feet, the retractile claws, and the powerful fore-limbs all unmistakably pointing to the same conclusion.

But the members of the dog tribe are as evidently intended for the pursuit of prey by rapidity of foot alone. The limbs are formed more for speed than for strength, and the head and shoulders do not possess the massive power found in the cats, which bury their teeth in the flesh of the victim, and retain their hold until the death-blow is given.

The members of the dog tribe, including the wolves, jackals, and foxes, differ from the cats in many points both of structure and habits.

It will be remembered that the latter animals feed chiefly upon prey captured by themselves; the dogs, on the contrary, will devour with equal avidity the flesh of any slaughtered animal which they may find, as well as offal of all sorts.

A glance at the feet will at once point out the reason. The claws, which in the cats are of such

service in the capture of prey, are in the dogs of comparatively little use for this purpose, being short, blunt, and non-retractile.

That there must be some original type of the dog is self-evident, though it is almost, if not quite impossible to ascertain with any precision what that type may be.

There is no similar difficulty about the wolves, foxes, and other members of the dog tribe, because they live a wild life, and so can preserve their own typical character. But the very nature of the dog compels it to withdraw itself from a wild life, and attach itself to man. More or less it becomes his companion, and does his work, and it is therefore necessarily modified according to the race, the climate, and the domestic economy of the human beings with whom it associates itself.

Take the cities of the East.

There we have the dog, not quite, but nearly wild, doing the work of man, by acting as scavenger, and so enabling man to live.

Take the semi-nomad North American Indian, who lives in tents, but remains for months, and sometimes for years, in the same locality. He is a warrior and hunter, and nothing else, utterly despising work, and, even if he does grow a crop of maize, delegating all the work to the women.

With him the dog becomes the guardian of the temporary village. He knows every inhabitant, and allows no stranger to enter unless accompanied by one of the warriors.

Go further north, and take the Esquimaux, an aggregation of equally nomad tribes, but inhabiting a region of almost perpetual snow and ice. Here the dog becomes the beast of burden and traction. He can have no roof to cover him, for his masters are themselves glad to huddle in their little huts of snow, which are hardly large enough to hold them and their families. So he is supplied with a coat of long and dense fur, which enables him to live where the smooth-haired dog would be frozen to death.

Should he belong to a pastoral race, he becomes the faithful guardian of the flocks. Should he belong to a race that lives by hunting, and has to contend for food with the wild beasts, he becomes the fierce and tireless hound. And should he belong to those who only want him to make a pet of him, he becomes a pet accordingly, useless, silly, and selfish.

All the varieties of the domestic dog are purely artificial, and as in these pages we treat of Nature, and not of art, we make no mention of them.

These, therefore, will be altogether omitted, and the wild animals of the tribe alone taken into consideration.

The first to be mentioned is the well-known Dhole, or Kholsun (*Cuon Dukhuensis*), which is found in the more western parts of British India.

The colour of the animal is a dark bay, the muzzle, ears, and tip of the tail being darker than the rest of the body. In size, it about equals a rather small greyhound.

Common though the dhole is in the country which it inhabits, it is seldom or never seen by the residents, owing to its timid and retired mode of life. By many travellers, indeed, it has been considered as merely a myth of the natives. In the dense jungles, however, it is abundant enough.

The most noticeable point concerning the dhole is its fondness for the chase. For the purpose of procuring prey it combines in large packs of some fifty or sixty individuals, and by sheer force of numbers contrives to overcome such large and powerful game as the wild boar and the tiger. And this is the more remarkable when we consider what insignificant weapons the dhole can bring to bear against the powerful tusks and talons of its adversaries. The secret of success, however, lies in its courage and pertinacity, for, although their comrades are being struck down on all sides, the survivors continue the attack without allowing their foe an instant's pause, and do not cease their onslaught until the unfortunate animal yields from fatigue and loss of blood.

The speed of the dhole is very considerable, even the swift-footed deer being unable to escape from their apparently insignificant pursuers. It is a curious fact that, while engaged in the chase, the dhole is almost silent, an occasional low whimper being the only sound ever emitted.

In Nepaul, and the northern parts of India, an animal nearly allied to the dhole is found, which is generally known as the Buansuah (*Cuon primævus*).

This animal, which is generally supposed to be the progenitor of our domestic dog, is very similar in habits and general appearance to the animal already described. Like the dhole, it hunts in packs, which, however, seldom consist of more than ten or a dozen individuals. It differs also in its habit of giving tongue while running, continually uttering a peculiar bark, very distinct from that of the domesticated animal.

The buansuah is often captured when young, and carefully trained for the chase, the wild boar being the selected quarry. For the purpose of hunting this animal the buansuah is very valuable, its sudden, snapping bite being far more effective than the attack of the ordinary hound. It is not so easily taught, however, to follow other game, being rather apt to relinquish the pursuit almost at the moment of capture.

The well-known DINGO (*Canis dingo*) of Australia must not be passed by without mention.

This animal is not thought to be an indigenous inhabitant of the continent it inhabits, inasmuch as all Australian mammals seem to be marsupials, but is supposed to have been imported from some unknown source many years ago. It is rather a handsome animal, being of a rich reddish-brown colour, sprinkled with blackish hairs over the greater part of the body: the ears are short and erect, and the tail is thick and bushy, almost as much so as the well-known 'brush' of the fox.

To the colonists and farmers of Australia the dingo is an unmitigated pest, ravaging the flocks night after night, and committing incalculable damage in a very short space of time. As many as twelve hundred sheep and lambs have been stolen from a single colony by these animals in the course of three months. And the cunning of the dingo, being little inferior to that of the fox, renders it a very difficult matter for the settlers to protect their herds from the attacks of the wily foe.

Like the dhole of India, the dingo hunts in large packs, each of which has its appointed sphere of action, and never trespasses into the district of another band. When attacked by human foes, it shows little inclination to fight except when brought to bay, whent i will attack its pursuers with great ferocity.

Various attempts have been made to domesticate the dingo, and with partial success; but its temper is always very uncertain, and it is always apt to attack

Dingo.

any passing human being, its own master not excepted, without the slightest provocation or apparent cause.

LEAVING the dogs themselves, we come to the closely allied JACKALS, which are found in many parts of the African and Asiatic continents. There are several species of these animals, of which the most abundant and familiar are the common Jackal, or Kholah (*Canis aureus*) of India and Ceylon, etc., and the

Jackal.

Black-backed Jackal (*Canis mesomelas*) of Southern Africa.

The former of these animals is found in very great numbers, but, owing to its nocturnal habits, is more often heard than seen, keeping up, as it does, a perpetual howl from dusk to dawn. It usually herds together in packs, which retire to the thick forest during the day, and sally out after dark in search of food.

Their prey usually consists of the smaller quadrupeds, which they can overpower without much difficulty. They are not very particular, however, and are equally satisfied with the carcase of any slain animal which they may happen to meet with.

The jackal is often known as the 'lion's provider,' owing to its habit of following closely upon the footsteps of the large members of the feline tribe. This title, however, is rather misapplied, for jackals follow a lion or tiger

solely for the purpose of preying upon what remains of the carcases of his prey after his lordly appetite is satisfied. A ring of jackals may often be seen surrounding a lion when engaged in feeding, patiently waiting until his wants are supplied and they can consume the remainder.

Occasionally a jackal will separate himself from his companions, and live in solitude. These hermit animals are terrible foes to the farmers, attacking the hen-roosts and sheep-folds by night, and causing great havoc amongst the assembled animals.

The fur of the jackal is of a yellowish-brown tinge, whence the scientific name, *aureus—i.e.*, 'golden'—is derived. In size, it rather exceeds the common British fox. Like that animal, it is possessed of a powerful and unpleasant odour, which, singularly enough, gradually dies away if the creature be kept in confinement.

The black-backed jackal of South Africa may be easily distinguished from the Asiatic species by the black and white markings upon the back. The size and general appearance of both animals are much the same; in habits also they are so similar that a detailed description is rendered unnecessary.

THE fiercest and most terrible animals of the dog tribe are found in the WOLVES, which inhabit almost all parts of the world, from the Arctic regions to the tropics.

There are several kinds of wolves, as well as many varieties, which by some authors are elevated to the rank of species. The best known of these is the Common Wolf (*Canis lupus*), which is so abundant in many parts of Europe. The colour of this animal is grey, rather thickly sprinkled with black hairs, and tinted in some parts of the body with a warm fawn hue; the lower parts of the body are almost white.

When found singly, which is not very often, the wolf is a comparatively insignificant enemy, his courage not being of a very high order; when banded together in packs, however, which is almost always the case, there are few animals which they cannot overcome. Even the bear himself often falls a victim to their attacks, and such powerful animals as the buffalo and the elk have little or no chance against them.

One great peculiarity in the wolf lies in its unwearying pertinacity when engaged in the pursuit of prey. Once fairly upon the trail, it follows up the victim with a long, swinging gallop, which carries it along at a wonderful pace, and is certain, sooner or later, to bring it up with the quarry, however fleet the hunted animal may be.

Wolf.

When the victim is once overtaken, its chance of escape is small indeed. The wolves crowd round it, attacking it with a series of fierce, snapping bites, each of which causes the teeth to meet in the flesh of its adversary. If one animal is killed, another at once takes its place, and before very long the issue of the struggle is decided.

When the victim is once slain, the wolves seem to lose all control over themselves, fighting fiercely for every morsel of the coveted flesh, and attacking each other with the most ungovernable fury. If one should be overcome, he is instantly devoured by the survivors, and it is even reported that any animal who is unfortunate enough to dabble himself with the blood of the victim is certain to share the same fate. A weak and sickly wolf, also, is sure to fall a prey to the ravenous hunger of its comrades.

The wolf is not very particular as to the nature of his prey, animals of all kinds, even to frogs, toads, and insects, supplying him with food.

It seems strange that so bold an animal as is the wolf as a general rule, should at other times exhibit the most utter cowardice. If a wolf is caught in a trap, for instance, his courage seems at once to leave him, and he cowers down in a corner of his prison, and allows himself to be slaughtered without offering the slightest resistance.

As is the case with the lion, too, its suspicious nature sometimes offers a chance of escape to its intended victims. Travellers, when chased by wolves, have more than once escaped by trailing a piece of rope, or some other object from the carriage, and changing it for another as soon as the wolves began to lose their suspicions.

The hunters also take advantage of this excessive caution, and protect their slaughtered game from the wolf as they do from the lion—viz., by planting a stick by the side of the carcase, and attaching to it a streamer of white cloth, which flutters in the wind, and deters the fierce animals from approaching.

The Black Wolf (*Canis occidentalis*) of America greatly resembles the last-mentioned animal, both in character and habits. In appearance also he differs only in a slight degree, and for a long time was considered to be nothing more than a permanent variety of the common species.

A smaller and more abundant animal, found in great numbers upon the vast American plains, is the Prairie Wolf (*Canis latrans*). These animals are always to be seen in great profusion upon the outskirts of the herds of bisons which populate the plains, hovering in the neighbourhood in the hopes of over-

coming any injured or weakly member of the herd. A considerable number also usually follow the hunter, feeding upon the carcases of animals which he has slain, and from which he has taken sufficient for his own requirements.

One of the best-known of the American wolves is the Coyote, or Cajote (*Canis ochropus*), which is equally hated and despised by the hunters on account of its skulking and cowardly nature. This animal, which is very abundant on the prairies, has more of a fox-like aspect than the other wolves. In general habits it presents no very great difference from the previously-mentioned species.

The young of the wolves vary from three to eight or nine in number, and are brought up in a kind of nest constructed by the mother, which is lined with moss and fur pulled from her own body. When they attain the age of six or seven months, the young wolves are able to take care of themselves.

In spite of their fierce and savage nature, wolves have occasionally been tamed and brought into subjection—such animals, of course, being captured when quite young, before their character was fully developed. A mixed breed has sometimes occurred, between the

strong is this scent, that any object touched by the fox retains the odour for a considerable period of time.

The fox seems to be aware of the possession of this peculiar property, although, in all probability, his nostrils are unable to perceive the odour; for when hunted he will try every means which occurs to his fertile brain to break the line of scent. For this purpose he employs a perfect variety of tricks, such as returning upon his own track for some little distance, and leaping off at right angles, in the hope of escaping before the fraud is discovered. The animal will even roll in any odorous substance he can find, in order to disguise his own peculiar scent, and mislead the hounds by causing them to imagine that they are upon the wrong track.

Many foxes become so crafty that they make their escape again and again, always contriving to elude the pack, until the hounds become completely dispirited, and consider the issue of the chase as a foregone conclusion.

There is a gravel pit in Kent which exhibits the cunning of the fox in a very singular manner.

The animal has burrowed into the ground at some

FOX.

tame wolf and the domestic dog, their offspring being especially powerful and courageous.

NEXT we come to the FOXES, of which there are several species. Formerly included by zoologists in the preceding genus *Canis*, together with the dogs and the wolves, they were separated by later writers on account of the elongated pupil of the eye, and also from the bushy nature of the tail. The ears, too, are always triangular, and are sharply pointed.

The best known of the foxes, of course, is that found in our own country (*Vulpes vulgaris*), and which is so familiar to us on account of the chase, for which it is specially preserved.

The colour of this animal is a rich reddish-brown, becoming rather lighter on the lower parts of the body. At the approach of winter the fur becomes perceptibly paler, and at the same time increases greatly in thickness, just as is the case with the stoat, although not to the same degree. The tip of the tail, or 'brush,' always retains a more or less whitish hue.

Perhaps the most remarkable point in the nature of the fox is the singularly powerful and unpleasant odour which is exuded from the body, and which proceeds from glands situated near the tail. So

distance from the mouth of the pit, carefully concealing the entrance to the 'earth' among the tangled vegetation. Carrying the tunnel on, a second exit appears in the side of the pit itself, some half-way to the ground.

When hunted, the animal was evidently accustomed to enter his burrow at the upper end, pass through it, and make his escape by leaping into the quarry, while the hounds were at fault above, the idea of the second exit not being likely to strike the huntsmen, at any rate for some little time.

The same craft and cunning is employed by the fox when pillaging the hen-roosts, etc., of the neighbourhood, his visits being paid with such caution that detection is rendered almost impossible.

Yet, cunning as is the fox as a general rule, on some occasions his craft seems almost entirely to desert him. The late Mr. Charles Waterton, in one of his well known essays, relates an instance of this want of sagacity.

A fox, visiting a poultry yard, had made off with eight young turkeys. Finding that his booty would more than suffice for a single meal, he buried five of his victims in a neighbouring garden, evidently intending to return on the following evening and resume his

banquet. But although the bodies of the slaughtered birds were carefully concealed, one wing of each was left projecting above the soil, thus pointing out the transaction to every passer-by. As Mr. Waterton remarks, 'An ass, in this case, would have shown just as much talent and cunning as Reynard himself had exhibited.'

Passing to the foxes of other countries, the American fox (*Vulpes fulvus*) deserves a passing mention. This animal is very variable in its colouring, specimens having been found of almost every intermediate hue between black and pale yellow. A black streak almost invariably crosses the shoulders, earning for the animal the alternative title of 'cross fox.'

The Arctic fox (*Vulpes lagopus*) is a very well-known animal, chiefly on account of the valuable fur, which is much used in commerce. During the winter, at which time it is most in request, the coat is of a beautiful silky white, darkening to a dull greyish-brown as the season advances. The Arctic fox inhabits the northern regions of Europe, Asia, and America.

This animal appears to be almost destitute of the remarkable cunning of the others of its race, being easily trapped, and allowing a hunter to approach within easy shooting distance. In one way, however, it is sagacious enough, possessing the power of imitating the cries of the birds upon which it feeds, and so enticing them within its reach.

SOMEWHAT resembling a very small fox in general appearance, the Asse, or Caama (*Vulpes caama*) merits a passing mention.

This animal is found in Southern Africa, where it is remarkable for its inroads upon the nests of the ostriches, the eggs of which it destroys in great numbers. Not being able to pierce the thick shell with its tiny jaws, it rolls the egg against a stone, or other hard substance, and so contrives to obtain the contents.

Passing by the Otocyon and the Fennec, we come to the last of the dog tribe which can be mentioned in this paper, and whose position in the family is as yet very uncertain. This is the Hunting Dog (*Lycaon venaticus*), which has been thought to constitute a connecting link between the dog tribe and the hyænas; a final decision, however, has not as yet been arrived at. In fact, the characteristics of the hyænas and the dogs are so curiously intermixed in this strange animal, that it must be a matter of extreme difficulty to relegate it to its true position in the scale of creation.

The colour of the hunting dog is a reddish-brown, mottled with black-and-white patches; the nose and jaws are black, and a black streak runs along the head between the eyes. The ears are large, and the tail is long and bushy.

Like the dhole and the buansuah, the hunting dog combines in large packs for the purpose of procuring game, generally choosing the night-time for its predatory excursions. Its sense of scent is wonderfully keen, and its speed very great, and it is but seldom that the hunted animal is allowed to escape.

It will be seen that, although the cat and dog tribes both include some of the larger carnivora, the two families are, in structure as well as in habits, essentially different; and that the distinctions between the domestic cat and dog are no greater than between their more savage relatives which have never known the loss of freedom.

(*To be continued.*)

'How I Teach Elementary Science.'

FOURTH SCHEDULE SUBJECTS: MECHANICS.

BY RICHARD BALCHIN.

IT is proposed to introduce 'elementary science' as a 'class-subject' in the Mundella Code. It is put on a level with Geography and Grammar, and a syllabus is given in which 'Mechanics' occupies a very prominent place. This indicates the value set upon such kind of instruction by the Department. I think I can trace the handiwork of one of the best known and most highly esteemed of H.M. Inspectors. I am, as may be supposed, especially gratified to find my favourite subject thus treated. Of the direct encouragement given to the teaching of Mechanics by the London School Board, I can speak from pleasant personal experience. It is no wonder it should be thus highly esteemed. It is the one subject above all others that lends its aid, in the words of Gambetta, to 'that progress which is the development of that capital given by nature, and which is called reason.' I suppose all teachers have read Sir John Lubbock's speech at York, as reported in the *Times*. I felt a certain personal interest in reading it. For a short time since, one of Her Majesty's Inspectors did me the honour to bring Sir John and Lady Lubbock to Gloucester Road to hear one of my lessons on elementary science. Well, I feel that when I am engaged in this kind of teaching, I am, though in a humble sphere, a fellow worker with those men of mighty minds, who met to listen to that remarkable address from their president.

I propose in this article to give an outline of the first lesson, dealing with 'matter in the three states: solids, liquids and gases. The mechanical properties peculiar to each state.' These are the words of the syllabus. If I had had the wording of this, I should have said: 'Matter; its three states, solid, liquid and gaseous; the physical properties peculiar to each state.' In order that the teacher should know what he is talking about, and clearly conceive of a plan for best presenting the subject before juvenile minds, it is necessary that he read Tyndall's 'Heat, a mode of motion,' and especially Grove's 'Correlation of the Physical Forces,' besides the ordinary text-books on Natural Philosophy. I have found a little difficulty in deciding what shall be the basis upon which to build up my explanation of the three states of matter. Whether I shall take 'heat' as the basis, and consider the motion of atoms in the liquid as greater that that of those of the solid, and the greatest motions of all, resulting in the gaseous state; or whether I shall regard the three states as being due to different degrees of attraction of cohesion among the molecules of the respective states. It is very doubtful whether any of our boys, even in Standards V., VI. or VII., really grasp the meaning of this resolution into 'motion' of any of the physical forces. And if they cannot grasp it, it is better to leave it alone, than run the risk of forming erroneous conceptions in their minds. We must remember, too, that the very existence of atoms and molecules is theoretical. It is a theory only. It is not a well-established fact or law, like that of gravitation among the physical sciences, or of evolution among the biological ones. On the whole I think it

better to found your explanation of the phenomena under consideration upon the difference of the mutual attraction of the molecules.

Now for the lesson. The division consists of about fifty boys in Standards V. and VI. On the table is a cubic block of chalk, a basin of water, a little heap of peas, and I have an india-rubber ball in my pocket. A gas pendant is of course in the room, the gas being turned on at the meter. The black-board is up and empty. I begin the lesson.

John Jones, come here: take this block of chalk in your hands; tell me what you know about it from only feeling it. Ans.—It is rough. Anything else? Ans.—It easily rubs off. Anything else? Ans.—It is a square. Is he quite right, boys, in calling that a "square"? Ans.—No, sir; it is a cube. Yes. Now shut your eyes and tell me the shape of this (handing him the ball). Ans.—Round. Again, boys, is he right in calling that "round"? No, sir. Yes, sir. Some boy says "Yes." Why? Ans.—Because it *is* round, every way. It is, but the cube is also "square" every way, yet you said it was wrong to call it "square." What is the proper word for this shape? Ans.—A globe or sphere. Just so. Now, Smith, you come here. Put your fingers in that basin of water and tell me its shape? Ans.—I can't feel any shape. No, you can't. It has no shape, and you cannot give it shape of itself. See, I place the chalk on the table and it remains there and keeps its shape. Now I will pour some water on the table. You see it does not remain there; it runs away. What do you think is in that pipe? Ans.—Gas. I am going to turn it on, but not light it. I want you two boys, in opposite corners of the room, to tell me when you begin to smell it. (After a few seconds)—I can smell it, sir. Yes, and so can I here. (A boy)—I can smell it. (Another boy)—And so can I. Yes, you can all smell it. Now I have turned it off. How much gas came out, think you, while it was turned on? Ans.—This room full. Indeed? Do you know how many cubic feet that would be? Ans.—No, sir. Well, then, this room is 20 feet long, 20 feet broad, and 20 feet high; and 20 times 20 times 20 is what? Ans.—8,000. Yes; then how many cubic feet of space is there in this room? Ans.—8,000. Now do you think that 8,000 cubic feet of gas passed out of that pipe during the few seconds it was turned on? Ans.—No, sir. Why do you think not? Ans. (a boy whose father is in the gas works)—Because gas is three shillings a thousand feet, so that would be twenty-four shillings for 8,000 feet. Well, what of that? Ans.—We have three or four burners in our house, going every night, and our gas only costs us 24s. for three months. (Another boy)—Please, sir, when you filled our little hydrogen-gas balloon the other day, at that burner, it took more than a minute to get quite full, and you told us that balloon held one cubic foot. Yes, that is true. Now, boys, there was really only about one cubic foot of gas passed out while I turned it on. (A boy)—Please, sir, how could it fill this room, then? Ah! that is just what I was about to ask you. (A boy)—It spread. Spread? What spread? Ans.—The gas. Do you know of anything else that would spread in this way? No answer? Well, suppose I bring a cubic foot of water, say that pail-full, into the room, would it spread all over it? Ans.—No, sir. How many cubic feet of water must I bring into this room to fill it? Ans.—8,000. And if I wanted to fill the room with chalk, how much? Ans.—8,000 cubic feet. Yes, and yet it seems that one cubic foot of gas will fill it. (A boy, holding up his hand.) Well? Please, sir, I can make a cubic foot of water fill this room. Can you? How? Ans.—Make it hot, and turn it into steam. Yes, but then it would be vapour and not water. (A boy)—I read in one of our library books that steam and water are just the same. Yes, so they are in composition; but water in a state of steam is not called water: you can turn the vapour into water by condensing it. But you have not answered my question as to how the one cubic foot of gas can spread all over this room. Can any of you tell me? No one? Well, now listen. What would you call the smallest conceivable divisions of this gas? Ans.—Molecules. Yes, there must be a certain number of molecules in a cubic foot of it, must there not? Ans.—Yes, sir. Well, are there any more molecules in the cubic foot when it has spread all over the room, than when it passed out of the pipe? No, sir. Then what must have happened to the molecules? No answer? Look, here is a little heap of peas on the table. Suppose I wanted to make them spread all over the table, what must I do? Ans.—Put them farther apart. Just so. Then, what must have happened to the molecules of gas? Ans.—They must have gone farther apart. Yes, they separated from each other. Now, why do not the molecules of water in that basin, or the molecules of carbonate of lime in that block, separate from each other? Now think. (A boy)—There must be something to keep them together. Exactly so: there must be, and there *is*, and I will write on the board the name of that 'something'—'Attraction of cohesion.' In the case of the gas, the molecules are not only not bound together, they fly apart. Tell me some word which is the opposite of 'attraction.' No one can tell? You two boys come here: stand together; now push each other away. There, you see, they nearly fell down. There was certianly no attraction; what was there? Ans.—Repulsion. Just so. Now, one of you boys try and put your finger into that piece of chalk. You can't? Ans.—No, sir. No, not very easily. Now put your finger into that water. Yes, that is easily done. What was it you pushed apart in the water? Ans.—The molecules of water. (A boy)—I could push apart the molecules of chalk with a nail and hammer. Yes, you could; but that requires great force. So in which of those two things is the attraction of cohesion stronger? Ans.—In the chalk. Now take out your books and write:—In solids, such as chalk, the attraction of cohesion is great; in liquids, such as water, the molecules move freely among themselves, for the attraction of cohesion is slight; in gases or vapours there is no attraction of cohesion at all, but repulsion, between their molecules.

End of lesson. In the next lesson I should explain that 'heat' diminishes and ultimately neutralises the attraction of cohesion.

'How I Teach Arithmetic.'

(*Continued from page* 329.)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

Having gone over the chief elementary steps—(*a*) to (*i*)—as in vulgar fractions, we will now work out

rather fully a number of exercises or problems, calling into requisition the steps gone over. I will first take six examples from my own Exercises in Decimals.

(1) Add together ·085 day, 17·15 hours, and 16·15 minutes. (No. 161.)

$$\begin{array}{r} \cdot085 \text{ day} \\ 24 \\ \hline 340 \\ 170 \\ \hline 2\cdot04\cancel{0} \text{ hrs.} \\ 60 \\ \hline \underline{2\cdot4\cancel{0}} \text{ mins.} \end{array} \qquad \begin{array}{r} 17\cdot15 \text{ hrs.} \\ 60 \\ \hline \underline{9\cdot00} \text{ mins.} \end{array} \qquad \begin{array}{rr} \text{hrs.} & \text{mins.} \\ 2 & 2\cdot4 \\ 17 & 9\cdot \\ 0 & 16\cdot15 \\ \hline \text{Ans. } \underline{19} & \underline{27\cdot55} \end{array}$$

We have first found that ·085 day = 2 hrs. 2·4 mins.; then that the ·15 hr. = 9 m., making the 17·15 hrs. = 17 hrs. 9 m.; then we have added the three numbers together.

(2) Supposing a boy to use ·095 inch of slate pencil a day, how many weeks, of 5 days each, would a stick of pencil 4·18 inches long serve, if it were useless when worn down to 2·03 inches? (No. 178.)

4·18 − 2·03 = 2·15 inches of useable pencil.
$(2\cdot15 \div \cdot095) = (2150 \div 95) = 22\frac{12}{19}$
$22\frac{12}{19}$ days = 4 weeks $2\frac{12}{19}$ days. Ans.

We have cleared the 2·15 and ·095 of decimals by multiplying each by 1000, equalling 2150 and 95; and as 5 days are a school week, we have divided the days by 5.

(3) Bought 4000 oranges for £7·865, and sold ·35 of them at ·075s. each, ·375 of them at ·011 crown each, and the remainder at ·85d. each: how much did I gain or lose on the whole? (No. 169.)

4000 × ·35 = 1400, and 4000 × ·375 = 1500
4000 − (1400 + 1500) = 1100 remainder.

	·075s. × 1400 =	105s.	0d.	
·011 cr. (or)	·055s. × 1500 =	82s.	6d.	
	·85d. × 1100 =	77s.	11d.	
	£13	5s.	5d.	selling price.
£7·865 =	£ 7	17s.	$3\frac{3}{5}$d.	cost "
Answer.	£5	8s.	$1\frac{2}{5}$d.	gain.

Each step of the above seems so simple and natural as to require no comment.

(4) If a labourer's wage of 2s. 8d. per day on the introduction of the decimal coinage is changed to 1 fl. 3 cts. 5 mils., how much (in present money) does he gain or lose by the change in a year of 308 working days? (No. 248.)

1 fl. 3 cts. 5 mils = £·135 = 2s. 8·4d.
Hence 2s. 8·4d. − 2s. 8d. = ·4d. gain per day.
·4d. × 308 = 123·2d. = 10s. $3\frac{1}{5}$d. gain. Ans.

(5) Bring £1 17s. 6d. to the decimal of £2 17s. 6d. (No. 290.)

The easiest way to work this exercise is to obtain the *vulgar* fraction, by getting both to half-crowns, $= \frac{15}{23} =$ ·6521739 +. Ans.

(6) Find the cost of supplying a school of 105 writers with ink for a year of 48 weeks, each week 5 days, supposing each scholar to use on an average ·0015 pint a day, and that ink be 2·95s. a gallon. (No. 207.)

$$\begin{array}{rl} \text{pints.} & \\ \cdot0015 & \text{each boy per day.} \\ 5 & \\ \hline \cdot0075 & \text{" " " week.} \\ 48 & \\ \hline 600 & \\ 300 & \\ \hline \cdot36\cancel{00} & \text{" " " year.} \\ 105 & \\ \hline 180 & \\ 36 & \\ \hline \underline{37\cdot8\cancel{0}} & 105 \text{ boys " "} \end{array} \qquad \begin{array}{r} \text{pints.} \\ 8\overline{)37\cdot8} \\ 4\cdot725 \text{ gals.} \\ 2\cdot95 \\ \hline 23625 \\ 42525 \\ 9450 \\ \hline 13\cdot93875 \text{ s.} \\ 12 \\ \hline \underline{11\cdot26500} \text{ d.} \end{array}$$

Ans. 13s. 11·265d.

(7) If an oz. of gold be worth $£4\cdot\dot{0}09\dot{9}$, what is the value of a bar of gold weighing $1\cdot68\dot{3}$ lb.? (Colenso's *Arithmetic*, No. 35, art. 47.)

$$£4\cdot\dot{0}09\dot{9} = £4\tfrac{99}{9999} = £4\tfrac{1}{101} = £\tfrac{405}{101}$$
$$1\cdot68\dot{3}\text{ lb.} \times 12 = 20\cdot2 = 20\tfrac{1}{5} = \tfrac{101}{5}\text{ oz.}$$
$$£\frac{405}{\cancel{101}} \times \frac{\cancel{101}}{5} = \frac{405}{5} = £81. \text{ Ans.}$$

In multiplying $1\cdot68\dot{3}$ lb. by 12, the repeater is eliminated: 3 × 12 = 36 = 4 nines exactly.

(8) Find the sum of £1·15 + 2·0625 guineas + ·0078125 of 32s., and reduce the result to the decimal of half-a-sovereign. (Colenso's *Arithmetic*, No. 49, art. 47.)

$$\begin{array}{r} £1\cdot15 \\ 20 \\ \hline \underline{\text{s. }3\cdot00} \end{array} \qquad \begin{array}{r} 2\cdot0625 \text{ g.} \\ 21 \\ \hline 43\cdot3125 \text{ s.} \\ 12 \\ \hline 3\cdot\underline{7500} \end{array} \qquad \begin{array}{r} .0078125 \\ 32 \\ \hline \cdot2500000 \text{ s.} \\ 12 \\ \hline \underline{3\cdot00 \text{ d.}} \end{array}$$

$$\begin{array}{rrl} £ & s. & d. \\ 1 & 3 & 0 \\ 2 & 3 & 3\frac{3}{4} \\ 0 & 0 & 3 \\ \hline £3 & 6 & 6\frac{3}{4} \text{ sum.} \end{array} \qquad \begin{array}{r} 12\overline{)6\cdot75} \text{ d.} \\ 10\overline{)66\cdot5625} \text{ s.} \\ \underline{6\cdot65625}. \text{ Ans.} \end{array}$$

Here we see that £3 6s. $6\frac{3}{4}$d. is easily brought to decimal of £½, by simply bringing the $6\frac{3}{4}$d. to decimal of a shilling, placing the 66s. to the left of it, and then dividing by 10; that is, moving the point one position to the left.

(9) How many yards of matting $2\cdot\dot{4}$ feet broad will cover a floor that is $27\cdot\dot{3}$ feet long and $20\cdot1\dot{6}$ feet broad? (Colenso's *Arithmetic*, No. 26, art. 47.)

This problem is best worked fractionally, as $2\cdot\dot{4} = 2\frac{4}{9}$, $27\cdot\dot{3} = 27\frac{3}{9} = 27\frac{1}{3}$, and $20\cdot1\dot{6} = 20\frac{15}{90} = 20\frac{1}{6}$.

$$(27\tfrac{1}{3} \times 20\tfrac{1}{6}) = (\tfrac{82}{3} \times \tfrac{121}{6}) = \tfrac{9922}{18} = 551\tfrac{2}{9}\text{ sq. ft.}$$
$$2\tfrac{4}{9} = \tfrac{22}{9}, \text{ and } \tfrac{22}{9} \times 3 = 7\tfrac{1}{3}\text{ sq. ft. in a yd. of matting.}$$

$$\text{Hence } 551\tfrac{2}{9} \div 7\tfrac{1}{3} = \left(\frac{\overset{451}{\cancel{4961}}}{3\,\cancel{9}} \times \frac{\cancel{3}}{2\,\cancel{22}}\right) = \tfrac{451}{6} = 75\tfrac{1}{6}\text{ yds. Ans.}$$

$$\text{Or, shortly, } \frac{82}{\cancel{3}} \times \frac{\overset{11}{\cancel{121}}}{6} \times \frac{\cancel{3}}{2\,\cancel{22}} = \tfrac{902}{12} = 75\tfrac{1}{6}\text{ yds. Ans.}$$

We will now take three more questions from those given to pupil teachers in June last, 1881.

(10) If 1·75 shares in a mine cost £11·25, what will 14·375 shares cost? (Males, 1st year.)

This exercise can also be best worked fractionally by bringing each lot of shares to eighths. $1{\cdot}75 = 1\frac{3}{4} = 1\frac{6}{8} = \frac{14}{8}$, $14{\cdot}375 = 14\frac{3}{8} = \frac{115}{8}$; £$11\frac{1}{4}$ = £$\frac{45}{4}$.
Then £$\frac{45}{4} \times \frac{115}{14} = \frac{5175}{56}$ = £92 8s. $2\frac{4}{7}$d. Ans.

(11) How many 'francs' must be transmitted from Paris to Berlin to pay a debt of 420 'thalers,' assuming a franc to be worth £$\cdot 041\dot{6}$, and a thaler £$\cdot$15? (Males, 1st year.)

£$\cdot 041\dot{6} \times 20 = \cdot 833\dot{3}$s. $= 8\dot{3}$s. = 10d.

Here, as explained under (*h*), in multiplying, we carry at nine instead of ten, and we have in $\cdot 833\dot{3}$ placed the point over the first figure of the same kind, $= \cdot 8\dot{3}$. £$\cdot$15 = 3s. = 36d.

Hence (36d. × 420) ÷ 10d. = 1512 francs. Ans.

(12) How many oranges at £$\cdot$084375 a dozen ought to be given for 378 eggs at $\cdot$0625s. each? (Females, 3rd or 4th year.)

$\cdot 0625 \times 378 = 23{\cdot}625$s., value of the eggs.
£$\cdot 084375 = 1{\cdot}6875$s., value of 1 doz. oranges.
Then $23{\cdot}625 \div 1{\cdot}6875$ = 14 doz. = 168 oranges. Ans.

The working out of the foregoing twelve questions will, it is hoped and believed, exemplify the rules and principles previously laid down for the working of decimals in any of the phases in which they are generally presented.

Although the Metric System of Weights and Measures is taught in the upper half of my first class, a question in which is given on each card of my decimal packet, space forbids me going into the matter. We therefore here close our remarks on the teaching of decimals.

After Decimals I generally teach Simple and *Compound Proportion*, although *Simple* Proportion only receives very scant attention from us, such questions being nearly always worked either from first principles or fractionally, as I have previously remarked. *Compound* Proportion, which includes those questions that have 5, 7, 9, etc., terms given,—that is, 2, 3, 4, etc., ratios and antecedent,—is a short method of working out a result which generally involves considerably more labour if worked out by first principles. I first explain and define ratio. Take the ratio 2 to 3;—here suppose that a number of apples is to be divided between two boys in this ratio, that is, that the former gets 2 to the latter 3;—that is, as we now understand fractions, that the former gets $\frac{2}{3}$ of what the latter gets; or the latter gets $1\frac{1}{2}$ times as many as the former. Explain also 4 to 5, 8 to 7, 21 to 20, etc. Show that a guinea is to a sovereign as 21 to 20, as the former contains 21s. and the latter 20s. Reverse the ratio, and show that a £ is to a G. as 20 to 21. Caution the boys here that when a question as to ratio is asked, the answer must be in accordance with the terms of the question, not the reverse. Thus, What is the ratio between a crown and a florin? Answer: 5 to 2, not 2 to 5, the latter being the ratio of a florin to a crown.

Now show how ratio is expressed,—as 4 is to 5, 4 to 5, 4 : 5, or $\frac{4}{5}$—each of which expresses the same thing. Ratio may be defined as the number of times, whether integral or fractional, that one number is (or contains) another—thus 5 to 6 denotes that the former is $\frac{5}{6}$ of the latter, and 6 to 5 denotes similarly $1\frac{1}{5}$ times. Now explain that a Simple Proportion expresses a pair of similar ratios, that two numbers are in the same ratio to each other as other two are. Thus 3 is to 4 as 6 is to 8, 3 being the same number of times (fractional—$\frac{3}{4}$) 4 as 6 is (of) 8;—generally expressed, 3 : 4 :: 6 : 8, or fractionally, $\frac{3}{4} = \frac{6}{8}$. Now show that in any Simple Proportion (2 ratios) the product of the means = the product of the extremes, hence, having any three of the numbers, we can find the fourth. Caution that when ratios exist between *concrete* numbers, they must be of the same kind, there being no ratio between horses and acres, or between boys and oranges. Illustrate by an example,—If 6 horses eat 10 cwt. of hay, how much hay will 15 horses eat? Here the ratio is not between horses and hay, but between 6 horses and 15 horses, the antecedents, and 10 cwt. and its consequent ratio in cwts. Hence 6 horses is to 15 horses as 10 cwt. is to the consequent; and as the product of the means (15 × 10) = 150, hence 150 is also the product of the extremes, and as one of the extremes is 6, hence 150 ÷ 6 = 25 cwt., the other extreme, consequent, or answer. Or, expressed by the old signs of Proportion or 'Rule of Three,' 6 h. : 15 h. :: 10 cwt. : 25 cwt. Expressed and worked fractionally we have 10 cwt. $\times \frac{15}{6} = \frac{150}{6}$ = 25 cwt. Ans.

The latter, or fractional method, is the form in which I represent and work all questions in Proportion, as I consider the numbers may be much more easily manipulated when placed vertically—especially when cancelling can be largely resorted to—than when placed horizontally. In the above question the answer required is cwts. of hay, hence I place the 10 cwt. as above; I then consider whether the answer will be greater or less than 10 cwt. If greater, I place the greater of the two other numbers above the line and the lesser one below; if less, then *vice versâ*. Of course, 15 horses will eat $2\frac{1}{2}$ times as much as 6 horses, hence the result—10 cwt. × $2\frac{1}{2}$ = 25 cwt. Example in Compound Proportion:—If 10 horses eat 6 tons of hay in 100 days, in how many days would 25 horses eat 12 ton? The first consideration in 'stating' or arranging the question for working is what the answer wants to be in—days, horses, or tons. Here we see that the answer required is the number of days, hence we put down the days given (100) as below. We next take two terms of the same kind which form a ratio, and consider, as if from them alone, whether the answer will be greater or less, as in the preceding question. As there are more horses, the hay, on that account, would last a shorter time, hence the 10 is placed above the line and the 25 below it. Again, as there is 12 ton of hay to be eaten, against 6 ton that was eaten, it is evident that, on that account, it will last more days, hence

$$\begin{array}{c} \text{days} \quad \text{h.} \quad \text{ton} \\ \dfrac{4\ \cancel{100} \times 10 \times 2\ \cancel{12}}{\cancel{25} \times \cancel{6}} = 80 \text{ days. Ans.} \end{array}$$

In arranging the above sum, after a little practice, nstead of putting down the full numbers, their simplest ratio only would be put down, thus $\frac{2}{5}$ instead of $\frac{10}{25}$ and $\frac{2}{1}$ instead of $\frac{12}{6}$, so that the work would stand thus:

$$\begin{array}{c} \text{days} \quad \text{h.} \quad \text{ton} \\ \dfrac{20\ \cancel{100} \times 2 \times 2}{\cancel{5} \times 1} = 80 \text{ days. Ans.} \end{array}$$

(To be continued.)

Memorandum of Agreement between Managers and Teachers.

By the courtesy of the National Society, Westminster, we are enabled to present our readers with the following valuable form of agreement recently issued by them:—

MEMORANDUM OF AGREEMENT made this day of , 188 ,

BETWEEN

Managers of the [*Boys', Girls', or Infants'*] School at , in the county of hereinafter called the said Managers, of the one part; and hereby appointed School Master [*or Mistress*] of the said [*Boys', Girls', or Infants'*] School, and hereinafter called the School Master [*or Mistres*] of the other part.

IT IS HEREBY MUTUALLY AGREED as follows:

1.—In consideration of the remuneration hereinafter provided, the said School Master [*or Mistress*] shall teach and serve as Master [*or Mistress*] of the said School, from the day of , 188 , under the direction of the Managers, in accordance with the requirements of the Committee of Privy Council on Education, and shall also, under the direction of the Clergyman of the parish [*or district*], instruct the children attending the said School in the Holy Scriptures, on the Catechism of the Church of England, and the rest of the Book of Common Prayer, at the times appointed on Week-days for religious instruction, and shall attend all examinations authorised by the Managers; the said School Master [*or Mistress*] shall also instruct the Pupil Teachers of the said School for the times and in the various subjects required by the regulations for the time being of the Committee of Privy Council on Education, and shall also, and in addition thereto, under the direction of the Clergyman of the parish [*or district*], give to each of such Pupil Teachers not less than [ ] hours' instruction every week in the Holy Scriptures on the Catechism of the Church of England, and the rest of the Book of Common Prayer.*

2.—The said Managers shall pay to the said School Master [*or Mistress*] the salary of £ per annum by [*quarterly or monthly*] payments on the day of the day of , the day of , and the day of , commencing with the day of next, and shall also make to him [*or her*] the following further payments,† viz.:—

(1) One part of the School pence; or [*and*]

(2). One part of the gross annual Government grant earned by the School after it has been reduced by deductions (if any) under Art. 32 (*a*) of the Code of 1881.‡
And further, such part shall be subject to be reduced by the amount of such deductions (if any) from the said grant as shall arise from causes for which the Teacher is solely responsible, and shall be paid to the said School Master [*or Mistress*] annually on the receipt of the said grant by the said Managers, but in the event of such deductions arising from causes for which the Managers are solely responsible, then no portion of such deductions shall be borne by the Master [*or Mistress*]; or [*and*]

(3) The said Managers shall also pay to the Master [*or Mistress*] the sum of £ per annum for each Pupil Teacher for the instruction of the same, such payment to be made quarterly [*or monthly*] on the aforesaid days.

3.—The said School Master [*or Mistress*], so long as he [*or she*] shall be Teacher of the School, shall have the use and enjoyment of the School-house with its appurtenances, and the said Managers shall keep the same in good and substantial repair, and shall pay all rates and charges thereon.

4.—The said School Master [*or Mistress*] shall be responsible for, and receive and keep an account of, the School pence, and shall retain the same in part-payment of his [*or her*] annual salary, and shall give credit for the same quarterly [*or monthly*].

5.—The holidays of the School shall not be less than weeks in each year, to be appointed from time to time by the said Managers.

6.—This Agreement may be terminated at any time by either of the parties hereto, on giving to the other of them any Three calendar months' previous notice in writing to that effect.

7.—On the termination of this Agreement from whatever cause, the School Master [*or Mistress*] shall receive a proportionate share of the aforesaid remuneration calculated up to the day of the termination of this Agreement, except that the proportionate share of the said grant, if any, shall not be payable or paid until the grant shall have been received by the said Managers.

8.—On the termination of this Agreement from whatever cause, the School Master [*or Mistress*] shall quit and deliver up possession of the Schoolhouse and premises occupied by him [*or her*], and in default thereof shall forfeit and pay to the said Managers the sum of 10s. for each day during which the house and premises shall be held over, in the nature of a house-rent accruing from day to day, and recoverable as rent in arrear, by distress or otherwise.

AS WITNESS the hands of the parties hereto the day and year first above written.

* If it is proposed that the Teachers shall undertake the management of the Sunday School, or of the Night School, or any other duties, it is recommended that such duties shall form matter of special agreement.

† As it may be agreed.

‡ ART. 32. The amount which may be claimed by the Managers (Articles 19 to 22) may be reduced—
(*a*) If it exceeds 17s. 6d. per Scholar in average attendance during the year (Article 13), by its excess above the income of the School from all sources whatever, other than the Grant, provided that this reduction does not bring the Grant below 17s. 6d. per Scholar.

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add up six hundred and eighty-three, four hundred and sixty-nine, seven hundred and fifty-six, and four hundred and eighty-three. Ans. 2,391.

(2) From six thousand two hundred and ten, take five thousand three hundred and four. Ans. 906.

(3) Add together,—eight thousand two hundred and sixty-nine, three thousand seven hundred and forty-eight, five thousand six hundred and ninety-two, and seven thousand four hundred and sixty-eight. Ans. 25,177.

(4) Take five thousand three hundred and forty from six thousand one hundred and three. Ans. 763.

Dictation Exercise.

father	**brother**	**earth**	**mouth**
mother	**flower**	**wood**	**feet**
sister	**water**	**nose**	**hands**

Where is my book? Here it is. Jane has a bird. He is going home. He has black hair.

STANDARD II.

(1) Subtract ten thousand nine hundred and ninety-nine, from twenty-one thousand six hundred and one. Ans. 10,602.

(2) Divide eleven thousand and ten, by six. Ans. 1,835.

(3) Multiply eighty thousand six hundred and seventy-four, by seven hundred and fifty. Ans. 60,505,500.

(4) Divide twenty-six thousand and five, by nine. Ans. 2,889 + 4.

STANDARD III.

(1) Divide seven hundred and sixty-nine thousand three hundred and thirty-five, by seven hundred and nineteen. Ans. 1,070 + 5.

(2) From seventy-one thousand and seventeen pounds and a penny, take eight hundred and seventy

pounds thirteen shillings and three farthings. Ans. £20,146 7s. 0¾d.

(3) Add together,—two thousand and ninety pounds six shillings and a halfpenny, three hundred and eight pounds and twopence three-farthings, eighty thousand six hundred and seventy pounds seventeen shillings and ninepence, ninety-one thousand nine hundred and nine pounds eighteen shillings and sevenpence halfpenny, and seven thousand eight hundred and fifty nine pounds sixteen shillings and a farthing. Ans. £182,838 18s. 8d.

(4) Subtract one hundred and one pounds two shillings and a penny farthing, from ten thousand and ten pounds and a penny. Ans. £9,908 17s. 11¾d.

STANDARD IV.

(1) Reduce (*a*) 10,000 ounces to tons, etc.; and (*b*) half a mile to inches. Ans. (*a*) 5 cwt. 2 qr. 9 lbs. 0 oz. (*b*) 31,680 inches.

(2) Multiply four thousand and six pounds eighteen shillings and tenpence halfpenny, by three hundred and thirty-five. Ans. £1,342,338 3s. 1½d.

(3) Divide one hundred and eighty thousand and seventy-eight pounds and sevenpence halfpenny into one hundred and twenty-five equal parts. Ans. £1,440 12s. 5¾d. + 33.

(4) A clerk spends 5s. 6d. a day, and is also able to save £35 12s. 6d. in the course of the year. Find his annual income. Ans. £136.

STANDARD V.

(1) Find the price of fifteen thousand and seventy guns, the average price of each being nine pounds three shillings and elevenpence farthing. Ans. £138,596 18s. 1½d.

(2) If 119 apples exactly fill a peck measure when apples are sold at the rate of 7 for 3d., what will two bushels cost? Ans. £1 17s. 0d.

(3) Find, by Practice, the value of 9 miles 14 poles at £5 6s. 8d. per mile. Ans. £48 4s. 8d.

(4) A bill:—4½ lbs. soap at 4¾d per lb.; 5½ lbs. of candles at 5¾d. per lb.; 3 lbs. of butter at 1s. 5½d. per lb.; 1 cwt. of rice at 2¼d. per lb.

	£	*s.*	*d.*
	0	1	9¼
	0	4	4½
	0	2	7½
	1	1	0
Ans.	1	9	9¼

STANDARD VI.

(1) Simplify:—

(*a*) $\dfrac{3\frac{2}{3}+5\frac{5}{6}}{\frac{2}{19}}$; (*b*) $\dfrac{5\frac{3}{8}-4\frac{1}{2}}{\frac{7}{8}}$

Ans. 1, 90¼. Ans. 2 = 1.

(2) A purse contained $\frac{5}{9}$ of 7s. + 1s. 3d. + 1·30 of 2s. 3d. + 1s. 3½d. + £3$\frac{5}{8}$. How much was there in it?

	£	*s.*	*d.*
	0	3	10⅔
	0	1	3
	0	2	11$\frac{1}{10}$
	0	1	3½
	3	12	6
Ans.	4	1	10$\frac{4}{15}$

(3) Reduce $\frac{6992}{9344}$ to its lowest terms, and bring $\dfrac{6\frac{11}{12}}{10\frac{3}{8}}$ to a simple fraction. Ans. (1) $\frac{437}{584}$. Ans. (2) $\frac{2}{3}$.

(4) If seven men mow an acre in two hours, in what time will fourteen men mow six acres. Ans. 6 hrs.

Grammar.

STANDARD IV.

Parse, A farmer, one very fine day, saddled his horse to go to the neighbouring town.

STANDARD V.

Parse and analyse, There is no sense nor reason in very many of his speeches.

STANDARD VI.

(*a*) Parse and analyse, On this the poor crow, whose head was completely turned by his flattery, cleared his throat to sing.

(*b*) Write a short essay on 'The great Snow Storm.'

Domestic Economy.

(1) Describe the different kinds of food, and say what nourishment each gives the body.

(2) What sort of copper is the best to wash in? Why?

(3) How would you wash a blanket?

(4) Why is it a good thing to wear flannel next the skin?

(5) Describe any fashion very injurious to health.

(6) Why is it best to do the washing at home?

——o——

Engagements for October.

October 3.	Education Society, 'Geometrical Teaching in Kindergartens.' P. Harding, M.A.	
	Opening of Social Science Congress, Dublin.	
4.	Whitelands College Scripture Examination.	
5.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m
	Entomological Society.	
7.	Finance of Orphanage, N.U.E.T. . .	7.30 p.m.
8.	Organisation Committee, N.U.E.T. .	10 a.m.
	Meeting of Executive, N.U.E.T. . .	11 a.m.
10.	Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
14.	New Shakspere Society	8 p.m.
	Finance of Benevolent Fund, N.U.E.T.	7 p.m.
15.	Finance of Provident Society, N.U.E.T.	10 a.m.
	General Board, N.U.E.T.	11 a.m.
17.	Education Society, 'Object Lessons.' T. M. Williams, B.A.	
	Central Committee of Benevolent Fund, N.U.E.T.	7.15 p.m.
	Second B.Sc. Examination, London University.	
19.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m
21.	Meeting of Executive, N.U.E.T. . .	7 p.m.
22.	Organisation Committee, N.U.E.T. .	10 a.m.
24	Education Society, 'When and in what Order should Subjects be introduced?' T. G. Fleay, M.A.	
	Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
28.	Browning Society, 'On the Characteristics of Browning's Philosophy and Poetry.' Rev. J. Kirkman, M.A.	

HODGE, THE MILLER.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.

Publications Reviewed.

Philips' Illustrated English Grammar. London: G. Philip & Son.

We suppose we must not object to the term illustrated, on account of the little book before us containing some dozen little wood-cuts more or less bearing upon the text, which is adapted for the third standard in the new code regulations. This little book really contains a great deal in the limited space of twenty-four pages, and while being explanatory is by no means diffuse. Some of the explanations are remarkably happy. Under the heading *Pronouns* we have the following explanation of the use of pronouns—to avoid repeating the same name in the same sentence:

Sentences.	*Combined: names repeated.*	*Combined: other words used.*
Mary had a lamb. Mary went to school. The lamb followed Mary.	Mary had a lamb, and (when) Mary went to school, the lamb followed Mary.	Mary had a lamb, and (when) *she* went to school, *it* followed *her.*

This is clear and should not be left, as in most grammars, to oral explanations. In this way most other leading features of English grammar are explained, and their use further exemplified by test questions. Altogether the book is highly commendable.

Grammar-Land. By M. L. Nesbitt. London: Houlston and Sons.

This humorous attempt to make grammar amusing to young children will doubtless be successful in lessening the difficulties and smoothing the path of the little learner. The fun is made quite subservient to the more important object of conveying a knowledge of the subject, and herein differs from the comic grammars, in which everything is sacrificed to the humorous. After a hearty laugh at the fun of this book, the reader cannot fail to acquire a fair knowledge of English grammar. The book has run through three editions, and will doubtless have a steady sale. As a holiday or reward book, it will be prized by the juveniles.

First Historical Reader (British School Series). By A. H. Dick. Gall and Inglis: London and Edinburgh.

This book is intended for the second standard under the new code, and, in regard to simplicity of style, well adapted to very young readers. In some cases this simplicity of style seems carried to excess. We fail to see the superiority of 'It is a rich, rich land,' to the more common 'It is a very rich land.' After a lesson on the supposed appearance of the country in the British period, the advent of the Romans is described, the resistance of Boadicea, the Druids, and next, the coming of the Saxons. We have thence a general sketch of the Saxon and Danish rule, down to the invasion of the Normans, and with the crowning of William this collection of pleasingly-written lessons ends. We commend the book, which is illustrated with capital engravings and useful maps.

Outline of Paley's Evidences of Christianity. By the Rev. R. O. Thomas. London: T. Murby.

Notwithstanding numerous modern objections, Paley is still regarded among the greatest and best guides to the defence of revealed religion, and among his works the 'Evidences' occupy the foremost place. In these days of examinations it is often desirable to obtain a summary of a great work, not merely for the object of gaining a general view thereof, but also to select some portion for deeper investigation. For either of these purposes Mr. Thomas's Outline is well adapted. The leading particulars of each chapter are presented with remarkable accuracy and clearness, with just sufficient explanation to prevent the 'Outline' from degenerating into a mere index. At the end is a valuable series of examination questions taken from university and other papers. The book will be invaluable to theological students.

Volcanoes and Coral Reefs. No. 4. Popular Science Lectures. By Thomas Dunman. London: Griffith and Farran.

This forms one of the lectures delivered at the Birkbeck Institution, Southampton Buildings. The author states and briefly discusses the disputed and probably never-to-be-settled theories respecting the source of the internal heat of the earth. Volcanic action is then described in connection, of course, with the leading examples. The overwhelming of Pompeii and Herculaneum by the lava dust, followed by torrents of rain, is detailed, and the superincumbent true lava shown to have been of later date. It is to the mere covering of rooms and cavities by this so-called *water-lava* (*lava d'aqua*) that the preservation of so many interesting memorials in these old cities is owing. By a stream of fiery lava all must have been destroyed by the great heat. The author, after noticing the enormous character of the Icelandic eruptions, briefly describes those of the Andes; and next, that of Kilanea, in the Sandwich Islands, the largest volcano in the world. The phenomena of earthquakes is similarly sketched, and the lecture concludes with an attempt to show a connection between coral reefs and volcanic action. The author does not detail the processes of coral development and multiplication, but attributes the formation of coral reefs and the submarine atoll, or submerged circular reef, together with the great depth of many coral rocks—far lower than where coral polypes could live—to a gradual sinking of the land. This subsidence, though slow, is supposed to be owing to a movement of the earth's crust, which produces the slow sinking of Southern Norway and Sweden, while the north of these regions is as slowly rising. Whether the theory of these gradual movements will entirely supersede the belief of ancient great catastrophes no one can determine. But we have said enough to show the interesting and thoughtful character of this lecture.

The gradual growth, if we may so term it, of the coral polyp is probably owing to the quantity of carbonate of lime taken by each individual in the mass of sea-water in which its food is found. The greater portion of this is exuded through the porous body of the polyp, but some portion remains and causes the solid mass gradually to render the exudation of the sea-water difficult. The zoophyte then leaves this lower portion, mounts upward, and so the perpetual growth proceeds until the surface of the ocean is reached.

Political Economy Reading Book. By R. H. Inglis Palgrave. London: National Society.

We do not know of any book in which the principles of political economy are presented in a more agreeable form than in the little volume before us. In a series of detached extracts, interspersed with suitable poetical quotations, we have a fair outline of the elementary features of economic science. When we mention that these extracts are taken from, or founded upon, such writers as Mrs. Fawcett, M. Bastiat, Mr. Stanley Jevons, and M. Bloch, the soundness of the opinions will be understood. Among others, we have extracts from Defoe, Cobbett, Franklin, and the ever popular *Evenings at Home*, together with modern writers, judiciously bearing upon the points at issue. The consecutive connectedness of the subject suffers, it is true, from this mode of treatment, but

the liveliness and readableness of the book are greatly increased thereby. The style, though of course varied, is, on the whole, well within the grasp of intelligent juveniles. The more recondite matters of rent, co-operation and other more advanced topics are not touched upon in these capital introductory lessons, which are calculated not only to please but to influence the minds of youthful readers, and prepare them to resist, if needful, attempts to regard apparent class-interests as superior to the general welfare.

It is remarkable that few writers on Political Economy excel such French authors as Bastiat and the more modern M. Bloch, largely quoted by Mr. Palgrave, while the French, as a nation, are disposed to submit to the fallacies of protection and to sacrifice the general good to the seeming welfare of a few interested producers. But we ought not to forget that our free-trade policy is little more than a quarter of a century old, and that it is even now threatened by ignorant attacks from interested sections. It is questionable whether the mass of our people understand clearly the wisdom of commercial freedom and the sophisms of restrictive efforts. It is, further, doubtful whether the great mass of our operatives are aware of the benefits that accrue to all from increase of produce, and whether they are not infatuated with the notion that the workman's interest is to restrain rather than increase productiveness. These and similar errors, of course, need but to be fairly stated to be exploded. But they have not been brought before the face of the working classes generally, and hence the prevalent notions that the less a workman does the more remains for him to do. This poisonous principle is widespread among our operatives. Generally speaking, our workmen are not lazy, but they fully regard it as due to the general interests of their order not to do more than they possibly can in the way of productive work, and to shackle the outcome of productiveness by every possible expedient. Mr. Stanley Jevons combats these fallacies in an admirable chapter on *The fallacy of making work*, and shows clearly that not only is the general welfare of the community enhanced, but that wages are also increased by increasing the produce of labour, and not by decreasing the produce. Nothing, we apprehend, is more needful in the way of education than to enable our schoolboys to form accurate conclusions on economic science. This book will admirably help them to do this, and carry on the work which was introduced and energetically developed as a subject for ordinary school instruction by the indefatigable and philanthropic efforts of the late William Ellis.

A Short and Complete Exposition of the French Verbs, and Rules of Genders of French Nouns. By one of the Professors of French, Downside College, Bath. 50 pp. sewn. London : Stewart and Co.

This unpretentious little manual, which forms part of Stewart's Educational Series, is in no respect worse, and in many respects very much better than its all too numerous predecessors. One of the main points which distinguishes it is that the Preface is seven lines instead of seven pages. It is not easy to underrate the comfortable feeling which this fact engenders. Nevertheless, truth requires that we should confess that as yet we have failed to perceive any adequate reason for the books existence. It cannot be urged that there is no French Grammar in the market, for a fresh one appears every month. Nor can very great novelty or very striking execution be pleaded, for there is neither the one nor the other. Let us, however, pass this point, and assuming the questionable right of *raison d'etre*, proceed to note the main features of the book.

Firstly, then, we have the assimilation of the French and English scheme of verb-tenses. It is doubtful whether this, and the consequent death of the time-honoured preterite, is an alteration which will commend itself to Frenchmen. We, however, think it might have been carried a little farther still. Such a name as 'Past Perfect Anterior,' for example, is an eyesore, inasmuch as, with all its lofty title, if it means anything at all, that meaning is certainly not what was intended. This is a comparatively small matter, but not without importance. We will now confess at once that this, the mainstay of the work, is so carefully and satisfactorily done that we have no fault to find with it. Perhaps it would be an improvement if *faillir*, *absoudre*, *luire*, and *traire* were moved from the list of Irregular Verbs to the list of Defective Verbs. Perhaps, too, it is foolish to insert obsolete forms. English grammars, of an elementary nature for instance, are rarely disfigured by such creatures as *pight (pitched)*, *holpen* (*helped*), *shope* (*shaped*), *arrove* (*arrived*). As it is equally unnecessary to burden French with *je faux*, *j'absolus*, *je luisis*, etc. However this may be, it is a decided improvement to clearly mark the *conditional* as a mood and not a tense, and to point out the analogy which subsists between the third and fourth conjugations, an analogy so close, indeed, as to justify our author in making one of two. 'In this treatise the verbs in *-oir* have been classified among the irregular verbs. The conjugation in *-oir* differs from that in *-re* only in the form of the indefinite infinitive.'

It is with the second part of the work, however, that we find most fault. There are some really serious omissions, which we proceed to notice. In the first list 'Gender known by Meaning,' 'Days (not holy-days), months and seasons,' are given as universally masculine, whereas *la mi-août* and *la mi-juin* are certainly feminine. Again 'Names of Winds' (with of course the usual exceptions—*mousson*, *brise*, *bise*, *tramontane*), are entirely omitted. If for nothing else than retaining similarity with Latin it is desirable to insert them.

In another list *amour*, *délice*, and *orgue* are given as masculine in the singular, feminine in the plural, while no notice is taken of the idiom which makes the latter two masculine in the plural after the expression *un de*.

And, finally, in the list on the concluding page of the book there are at least thirty omissions, of which five only are so important as to render their absence culpable. We refer to the different significations, according to gender, of—*guide*, *merci*, *palme*, *solde*, *triomphe*.

To conclude, the survey of this book is absolutely refreshing after all the nonsense of some of its predecessors. True, at the best it is a weary business, which we conclude with heartfelt satisfaction ; but, to our mind, the French Grammar is yet unpublished that is other than weary.

Murby's Imperial Reader. Book IV. London: Thomas Murby.

We have not seen the other volumes of this series, but if they are as meritorious as this Fourth one before us we should conclude they would have an extensive sale. This volume contains a judicious admixture of the didactic and instructive with the lively sketches and tales that are sure to interest young readers. The book opens with one of these tales—a story of a fox—in which Reynard narrates his methods of escape when pursued by the hounds. A lively lesson on a plum pudding shows the need of the efforts of many to supply very simple wants. Then comes *A chat with the Ostrich*, in which the natural history of the big bird is learned by its telling its own tale, as did the fox. This taking method of letting animals and objects speak for themselves, is carried out in several lessons in this book, and in none better than the pretty story of *Pink Shell and Sea Weed*, in which the folly of pride is kindly reproved. The lesson on *Chalk* is valuable from a geological point of view. Sketches of the Ancient Britons and others on history are agreeably interspersed with good poetical extracts, many of which are new, and the others old favourites. The illustrations are by no means scanty, and in all cases appropriate.

The Victoria Table Book. 48 pp. Ormskirk: T. Hutton.

In addition to the tables needed for the ever-varying code, this cheap Table Book contains a mass of valuable information.

Invariable Stocking Scale. By Miss Heath. London: Griffith and Farran.

This 'scale' is printed on extra stout paper, 22½ inches by 30½ inches. A drawing of the stocking the full size of the sheet is given, with easy instructions applicable to any size of stocking, or sort of wool used. An expert 'knitter' assures us that the instructions which appear in very large type could not be improved.

Twenty Minutes' Talk with Parents. London: Isbister.

The 'friend of education' who has penned this sensible essay is no novice at his work. Every page—we had almost said every sentence—reveals so keen an insight into elementary school life, that it is hard to believe anyone not engaged in the actual work of education could produce it. The writer shows that it is to the advantage of the parent, as well as the child, that the latter should have a good 'schooling,' and answers conclusively the silly complaints of the croakers who aver that we are over-educating the working-classes. The pamphlet is full of the best advice, some of which is pointless now that Mr. Mundella's 'proposals' have appeared. If School Boards could scatter it broadcast they would do good service.

Early Glimpses. By J. R. Blakiston. 96 pp. fcap. 8vo. London: Griffith and Farran.

This is an *attractive* book—one that children will delight to use; the binding is neat, the type bold and clear, the illustrations admirable, and the language—a most important recommendation, by the way—well within the grasp of a good Standard I. class. As an example of Mr. Blakiston's simple, yet vigorous style, we give the opening paragraph of the chapter on water:—

'Though a strong friend, water is a stronger foe—a slave that sometimes turns and rends his master. Turned to steam, it bursts boilers, knocks down houses, and kills men. Turned to ice, it cracks strong pipes, and rends rocks.'

We deem it an excellent first Geographical Reader.

Universal Instructor. Part XI. London: Ward, Lock and Co.

An excellent part of Messrs. Ward and Lock's now well-known valuable serial.

German Phraseology. 156 pp.

German Prepositions. 151 pp. London: Crosby Lockwood and Co.

These two new books are useful additions to Lockwood's cheap and elementary school series. They furnish excellent work supplementary to the ordinary text-books on German.

A Complete Course of English Grammar and Analysis. By David Campbell, Montrose Academy. 156 pp. London: Thomas Laurie.

English Grammar is a subject which nowadays is attacked as frequently as French verbs, and with as little provocation. In our opinion, moreover, it is, of all subjects, the one of which the system of elementary teaching at present in vogue can be least improved. To assert, therefore, that we heaved a sigh on meeting with this newest effort is scarcely to do justice to our feelings. Not that our author has failed in his object; quite the contrary; but that the attainment of that object is, we humbly think, utterly unnecessary.

The book opens with various pithy remarks, mostly borrowed, on the teaching of Grammar. We take one from Dr. Abbott—'...The main object of a teacher teaching English Grammar to English children—viz., to teach not so much what as why.' With this we thoroughly agree, but our author, if we may judge from his preface, is only a partial believer, else he would scarcely have written the following:—'As this is a practical exercise-book for scholars, it has been deemed advisable to omit many interesting and philological facts. ......Fascinating as such information is, in any shape, it is believed that the freshness it acquires in oral teaching brightens the lesson for both class and teacher.' Such reasoning is good only at the surface. Its result in the present case is a book which is as irremediably dull as a fashionable novel or a French grammar written by a native. We maintain that derivations, not classical merely, but Anglo-Saxon, are the very essence of Grammar, that in fact Grammar becomes hopelessly dry bones without them.

There is but one excuse which could justify the course Mr. Campbell has adopted. His own, that this information acquires remarkable freshness at the hands of an ordinary teacher, is paltry, even if true. Besides this, so far as our judgment extends, it ought, if it applies to any one branch of education, to apply to all. We can understand our author's reasoning, however, on the supposition that he has meant his book for the youngest board-school classes. If this be the case, why add a chapter on Shakesperian English? Surely it is not customary to read Shakespere before knowing how to speak correctly.

We do not like the definitions here given. Nine out of ten are seriously faulty, and we should be at the trouble of pointing out these faults if we were not of the opinion that in Grammar definitions are either useless hairsplitting and haggling, or wordy nonsense, standing, to an eager aspirant for knowledge, in much the same relation as a piece of unconscionably tough leather does to a hungry man.

But let us not give our readers the impression that the workmanship of the book is bad. One of his objects is really well attained—that given in a quotation from Mr. Fitch.

'One good test of a grammar, or delectus, or manual of any kind is this: Does it, as soon as it has helped the student to know something, instantly set him to do something which requires him to use that knowledge, and to show that he has really acquired it?'

Judged by this criterion Mr. Campbell is almost too perfect. No sooner has any rule been given than the unlucky urchin under this guidance is pounced down upon for example after example, until the number of changes rung on a simple series cannot but have a monotonous effect.

An appendix, or summary of the book is added. Its main recommendation in the eyes of the schoolboy will be one which was probably far enough from the author's intention—its evident adaptability to the process of cramming.

Handbook to Types of Nations. London: W. and A. K. Johnston.

Very recently we noticed the admirable decorative schoolroom sheets, entitled 'Types of Nations,' issued by the above firm. We have now before us a descriptive handbook to these 'Types.' All teachers will find it useful, but more particularly those whose good fortune it is to have their walls adorned with the life-like pictures which are herein described. There are chapters on the Esquimaux, Negro, Australian Aborigines, Patagonian, Hindoo and Chinese.

Domestic Economy Test Cards. In three stages. London: W. and R. Chambers.

We have pleasure in noticing this carefully prepared series of cards; all the more so because we are frequently asked by our friends to recommend a really good set of Domestic Economy Questions.

These three packets fully meet the requirements of the three stages. On each card there are six different questions, and in each packet thirty different cards. The cards are enclosed in a plain, serviceable cloth case, and may be had at the modest figure of a shilling per packet. Chambers' Domestic Economy Test Cards are the best we know.

The Marlborough Arithmetic Test Cards. For Standards II. to VI. By T. B. Ellery. London: W. and R. Chambers.

In these days of 'catch' questions and variable standards of examination, no wise teacher will confine himself to one, or even two sets of Test Cards. Mr. Ellery's sums afford excellent practice on examination work. There is a judicious admixture of problems, many of which bear a strong likeness to those actually set by Her Majesty's Inspectors of Schools. Another good feature is that the answers to each item of the Bills of Parcels in Standard V. are given *separately*. The card upon which the questions have been printed is far too thin and flimsy, and we are afraid will not last long. Thin card may be admissible when but seldom used, as in the specific subjects: for Arithmetic in daily use it should be stout.

The Historical School Geography. By Charles Morrison, M.A., etc. London: Simpkin and Marshall.

This book is worthy of a place among the leading text-books on geography for Pupil Teachers and Students. It combines the leading features of history connected with the more important geographical facts, and herein differs from most geographical text-books, in which history is only occasionally introduced. Another feature of Dr. Morrison's book is the direction given in regard to the pronunciation of local names. These are not so extensively given as we could wish, but we are glad to see those that are affixed, together with many wearing their etymological explanations. Another addition in this book beyond the ordinary run of geographies is in the biographical summaries, containing the names of the most eminent men, with a list of their principal works, or the principal events in which they took a leading part.

The introduction treats as usual of (1) Mathematical geography and (2) Physical; the latter being remarkably well written, and with clear yet concise explanations. Among recent authorities the researches of the *Challenger* are quoted. The explanation of the tides is hardly satisfactory. 'Although a very small body (the moon) compared with the sun, she is so much nearer to the earth than the sun, that she exerts a force six times greater on the surface of the waters than the sun does.' Now the tides are not owing to the amount of attraction exerted by the moon on the waters, (which amount of attraction is much less than that of the sun, notwithstanding the moon's proximity to the earth,) but to the differences of attraction exerted by the moon on different sides of the earth. In other words, the earth's diameter, 8,000 miles, forms so important a proportion of the moon's distance, 240,000, that the moon attracts the side of the earth about $\frac{1}{30}$th stronger than the opposite or remote side of the earth. Consequently, the waters rise in a tidal wave under the moon from being more strongly attracted than those nearer the centre (of the surface) of the earth, while on the opposite side of the earth the waters fall back, being less attracted than the central waves. The diameter of the earth, indeed, forms no more appreciable proportion in comparison with the sun's immense distance, 92,000,000 miles, than does one step in regard to a building ten miles distant, and therefore the sun may be said to attract all sides of the earth alike. It is only by these *differences of attraction* that the tidal wave on the side of the earth remote from the moon, can be accounted for. More care is given by Dr. Morrison in explaining the distribution of man, plants, and animals, than is bestowed in most geographies. The same may be said in regard to the atmospheric and other influences on climate; indeed the chapter on the AIR is a model of succinct accuracy. We cannot also speak too highly of the introductory chapter generally descriptive of Europe, which is not only complete, but presents several matters in an attractive and novel manner. Mr. Morrison speaks of the English as belonging 'to the Saxon race, with a slight mixture of Danes and Normans,' a conclusion pretty well dispelled by the investigations of Huxley, Dr. Nicholas, and many other leading authorities. In the description of the various countries of the earth, we have much to commend, and not a little to mark as evincing very careful investigation and happiness of expression. In regard to Ireland—the puzzle of the wisest, and almost despair of the most hopeful, Mr. Morrison remarks, 'Were it not for the drinking customs which still prevail, political agitation, and religious partizanship, the Irish people would not be inferior to any European nationality.' To this we may add the tendency of the Irish to expect to have everything done for them. They ask for grants to provide boats and nets to prosecute their fisheries; grants for harbours; grants for packet stations; grants to enable the tenant to buy the land he cultivates, as if grants were obtained from some exhaustless mine of wealth, and needed only a Parliamentary vote to apply, forgetting that all these grants are to be obtained only from the taxes paid by the community at large. In describing the British possessions, the cession of the Transvaal to the Boers is named, and other instances occur of the information being brought down to the present date. Prince Edward's Island should be corrected to Prince Edward Island, although it is not unlikely that the latter will soon yield to the former term.

Altogether Dr. Morrison's book is a decided advance beyond the dry compendium of names and mere skeleton-statements that characterize many geographical text-books. It is high time that many of these gave way, for such thoughtful and well-written manuals as that before us. We should suggest a more extended explanation of local names, which should include not only those of countries and towns, but also of mountains—frequently given in Dr. Morrison's book—and rivers. These names of natural features generally carry us back to the earliest known history and condition of a country, before successive races gave their own names to the lands they conquered, and named their towns and cities from their own vocabularies. The names of mountains, rivers, and other natural features were, however, generally adopted by new settlers, and remained unchanged by them. Hence most river-names throughout Europe can be traced back, through Gaelic and other Celtic channels, to the Sanscrit, in which even a letter was often highly significant.

The names of our Avon, Ouse, Kennet, Rother, are plainly thus traceable, and so also are the great majority of other river-names, not only throughout Great Britain, but wherever the first branches of the Sanscrit, the earliest forms of European speech, spread. Dr. Morrison has, we think, done wisely in placing these etymological explanations as foot-notes in preference to collecting them at the end, where they have less chance of receiving attention. Many names are explained by Dr. Morrison with the text, as Ceylon (the island of lions), Hong-kong (Sweet Water), Holland (Hollow Land), Malta (*Melita*, from *mel*, honey), Turkestan (the land of the Turks), etc. All these help much to associate sound with sense, and to invest geographical names with interest. The following remark under the head EDUCATION (in England and Wales) will interest our readers:—'It is rather behind (that of) some other countries, but is now rapidly advancing. In addition to voluntary primary schools and private adventure, middle-class schools, NATIONAL BOARD SCHOOLS have now been established in every district where education was found to be defective. It is compulsory on all children between five and thirteen years, and free to the children of all parents too poor to pay the prescribed low fees. Religious instruction is given to all children whose parents do not object to receive it.'

An Easy and Rapid Method for Learning French Regular and Irregular Verbs.

By A. E. Ragon. 54 pp. London: Longmans.

On first sight we were very much pleased with this newest attempt to popularise the French verbs. The publishers' names were sufficient guarantee that the book was nicely printed. This was one fact very much in its favour, for, as a matter of experience, we could name several who think no dress too ugly, no type too unimpressive for such a bald and antiquated subject as ours. Again, the design of the book seemed new, and this was still another argument in its favour. As a rule, too, the author seemed to be almost able to speak English. Of course, now and then he talks in a decidedly *un*-English manner, witness for example: 'Now, *it requires only to know* . . . . *to acquire*, etc.' Still, such a moderate example as this, is the purest Ruskinian in comparison with some specimens that we have been favoured with in the past.

But we must confess, that notwithstanding these prepossessions, our further investigation scarcely supported the judgment which we formed at first sight. We will try to give our readers an account of the new system along with the arguments for and against. Verbal endings are, by our author, divided into 'particular and general.' 'The general endings are, with a few exceptions, those forms which terminate every French verb, regular or irregular; the particular endings, placed before the general endings, mark the various inflections which generally divide verbs into four divisions, called conjugations, or indicate that the verb is irregular.' The system will now be obvious. The general verbal endings are first learnt. These form a fairly easy table on p. 4, with about twenty-five exceptions to the rules there given. The next step is to grasp the ordinary rules for the derivation of any given tense from the primitive tenses. Next, to commit to memory 'which *particular ending* is used for each principal part, or at which particular part none is wanted.' This done our education is complete.

At first sight the plan is plausible, and not without a certain sort of ingenuity; but on investigation, we believe that the labour required will be found to be almost as great as before, while it is of a kind which is far less fruitless than previously. Of course, for regular verbs, it is plain sailing, and very easy too. For each conjugation, supposing the first table known, we have only five endings to learn and the whole business is done. But it is with the irregular verbs that we get into difficulties, which is a pity, because it is for their sake only that we embarked with our author. Let us take the verbs, *avoir*, *falloir*, *mouvoir*, *pleuvoir*, *savoir*, *surseoir*, *valoir*. Surely, we think with these, which are so much al ke in form, we shall fare well. But what is the fact? We are taught to look at the verbs thus:—*a-voi-r*, *f-alloi-r*, *m-ouvoi-r*, *pl-euvoi-r*, *s-avoi-r*, *surs-eoi-r*, *va-loi-r*. This is horrifying. How about etymology? Here in *valoir* the *l* is divorced from the *val*, just as if it were no part of the stem. Not to speak of the abomination of uni-litteral roots and many other staring anomalies. And what is gained by all this? Scarcely clearness, for it is most misleading. Nor shortness, for where in our old method we learnt the parts separately, here we have to learn arbitrary endings, for which mnemonics become impossible.

Thus we cannot but speak unfavourably of the book as a whole. The regular verbs are not perfectly done, nor can they be while it is permissible to use such vague generalities as—'Verbs in *eler*, *eter*, ... when *sometimes l* and *t* are doubled before *e*.' As for the irregular verbs any who buy this book should, in our opinion, leave out all this nonsense about 'particular endings,' and they will then find it a very serviceable guide through a subject which never appeared to us to present half the difficulties, the existence of which Frenchmen are accustomed to assume.

Matriculation Chemistry.

BY E. W. V. VOLCKXSOM,

Lecturer on Chemistry at St. Gregory's College, Downside, Bath

OXYGEN, O^{II}*

$$\frac{(O_2)\ \text{Molecular Weight, } 32.}{} = \text{Sp. gr. } 16.$$

Molecular Volume, $\boxed{}\boxed{}$

Or 16 grams of Oxygen occupy a volume of 11·2 litres.
16 grains of Oxygen occupy a volume of 44·4 c. inches.

OXYGEN. O^{II}.

59. Describe some of the most important natural substances in which **oxygen** is contained, and explain the preparation of the gas from the **black oxide of manganese**. *June*, 1865.

Firstly, **oxygen** is found in a free state in the atmosphere, forming about one-fifth of its volume. Air is a mixture of gases, chiefly nitrogen and **oxygen**. It is perfectly transparent and without smell.

Again, water is another important natural substance containing **oxygen**. Water at the ordinary temperature is liquid, but easily assumes the solid or gaseous form. When seen in small quantities it is colourless, but when observed in large quantities it has a bluish-green colour. When pure it is tasteless. It dissolves with great readiness very many substances.

Oxygen also forms part of many compounds, both animal and vegetable, as wood, sugar, and the flesh and fat of animals. It is so widely distributed in nature that it is said to constitute one-half of the weight of the earth. It also forms the greatest part by weight of water.

When **oxygen** is wanted in great quantities, it is usual to prepare it from the black binoxide or **dioxide of manganese** (MnO_2). The mineral manganese is strongly heated in an iron mercury bottle, fitted with an iron exit-tube. Yet, however strongly the mineral be heated, only one-third of its **oxygen** is given off.

The equation expressing the reaction is:—

$$\underset{\substack{\text{Manganic}\\\text{dioxide.}}}{3(MnO_2)} = \underset{\substack{\text{Trimanganic}\\\text{tetroxide.}}}{Mn_3O_4} + \underset{\text{Oxygen.}}{O_2}$$

60. Describe the preparation of **oxygen** from **chlorate of potash**. Give symbols of the decomposition.—*June*, 1864.—*June*, 1867.—*Jan.*, 1881.

The chlorate of potash or **potassic chlorate** is first powdered and dried, in order to prevent decrepitation and deposition of moisture in the tube, placed in a test-tube fitted with a cork and exit-tube, and carefully heated; the salt first melts and appears to boil from the evolution of **oxygen**. A high temperature is required to obtain the maximum of **oxygen**, when potassic chloride remains in the tube.

* The signs I, II, III, IV., . . . , placed to the right of a symbol, indicate the valency of an element.

The change is represented by the following equation:—

$$\underset{\text{Potassic chlorate.}}{2KClO_3} = \underset{\text{Potassic chloride.}}{2KCl} + \underset{\text{Oxygen.}}{3O_2}$$

It is usual to add to the **potassic chlorate** about one-fourth its weight of dry powdered black oxide of manganese (manganic dioxide); the two substances are well mixed, placed in the test-tube, which is held horizontally, and then heated. Under these circumstances the **oxygen** is produced at a lower temperature, but is slightly contaminated with chlorine. The black oxide of manganese remains unchanged.

61. Describe and explain the preparation of **oxygen** from **mercuric oxide**. *June*, 1872.

By heating dried **oxide of mercury** (HgO), at first carefully, in a strong glass tube. After a short time minute globules of mercury will collect at the upper part of the test-tube, showing thereby that the decomposition has commenced.

On continuing to heat the tube, **oxygen** is given off and may be collected at the pneumatic trough, and globules of mercury are formed in the tube, while the **mercuric oxide** gradually disappears, thus showing that the application of heat resolves the **mercuric oxide** into its elements, mercury and oxygen.

The reaction may be represented by the following equation:—

$$\underset{\text{Mercuric oxide.}}{2HgO} = \underset{\text{Mercury.}}{2Hg} + \underset{\text{Oxygen.}}{O_2}$$

62. How did Lavoisier show the presence of oxygen in air? *June*, 1866.

Describe the experiment by which Lavoisier proved air to consist of **oxygen** and **nitrogen**. *June*, 1869.

Lavoisier originally kept mercury (Hg) for many days at a temperature near its boiling point, in contact with a known volume of air. At first absorption took place, but after a time ceased, while during the absorption red scales were formed on the surface of the metal. One-fifth of the air was absorbed, while the remainder was no longer able to support combustion. Lavoisier afterwards heated the red scales at a much higher temperature than that at which they were formed, and thereby resolved them into quicksilver (Hg) and a colourless gas which had the power of supporting combustion more brilliantly than air, and which, when added to the gas left in the first part of the experiment, restored to it all its original properties. He named the gas which so strongly supported combustion **oxygen**, and the compound which it formed with mercury, **oxide of mercury**.

63. By what means can **oxygen** be separated from atmospheric air and obtained in a pure form? *June*, 1864.

One method would be to repeat the experiment by which Lavoisier proved the presence of **oxygen** in the composition of the air. (For the description of this experiment see No. 62.)

A second method would be to pass a current of air over very strongly heated **baryta** (BaO), which, by absorbing one atom of **oxygen**, is changed into **barium dioxide** (BaO_2). This last compound when heated to a still higher temperature is changed back into **baryta**, setting free the atom of **oxygen** which it had previously absorbed, and thus the operation may be continued.

The reaction may be thus represented:—

$$\underset{\text{Baric oxide.}}{2BaO} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Baric dioxide.}}{2BaO_2}$$

and

$$\underset{\text{Baric dioxide.}}{2BaO_2} = \underset{\text{Baric oxide.}}{2BaO} + \underset{\text{Oxygen.}}{O_2}$$

64. Describe two of the best methods of obtaining **oxygen**. How much heavier is it than **hydrogen**? —*Jan.* 1862.—*Jan.* 1863.

Describe one or more of the processes usually followed in preparing and collecting **oxygen** gas.—*July*, 1851.

The two best methods of obtaining **oxygen** gas are to decompose potassium chlorate ($KClO_3$) in the presence of dioxide of manganese (MnO_2), and to submit to a great heat the mineral black oxide of manganese. These two methods have been described in Nos. 59 and 60.

Oxygen is sixteen times heavier than **hydrogen**. In order to collect the gas, the lower end of the bent tube in communication with the flask dips under the surface of water in a pneumatic trough; and the gas, on being evolved, bubbles out from the end of the tube, and is collected in bottles filled with water and placed with their mouths downward in the trough.

65. Describe by equations as many processes as you know for the preparation of **oxygen** gas.—*Jan.* 1870.

Explain by chemical formulæ three distinct methods by which **oxygen** gas can be prepared.—*Jan.* 1877.

1st. By electrolysis of **water**:—

$$\underset{\text{Water.}}{2H_2O} = \underset{\text{Hydrogen.}}{2H_2} + \underset{\text{Oxygen.}}{O_2}$$

2nd. From **oxide of mercury**:—

$$\underset{\text{Mercuric oxide.}}{2HgO} = \underset{\text{Mercury.}}{2Hg} + \underset{\text{Oxygen.}}{O_2}$$

3rd. From **potassic chlorate**:—

$$\underset{\text{Potassic chlorate.}}{2KClO_3} = \underset{\text{Potassic chloride.}}{2KCl} + \underset{\text{Oxygen.}}{3O_2}$$

4th. From **black oxide of manganese**:—

$$\underset{\text{Manganic dioxide.}}{3MnO_2} = \underset{\text{Trimanganic tetroxide.}}{Mn_3O_4} + \underset{\text{Oxygen.}}{O_2}$$

5th. From **potassium dichromate** and **hydric sulphate**:—

$$\underset{\text{Dipotassic dichromate.}}{2K_2Cr_2O_7} + \underset{\text{Hydric sulphate.}}{8H_2SO_4} = \underset{\text{Potassic sulphate.}}{2K_2SO_4} + \underset{\text{Chromic sulphate.}}{2Cr_2(SO_4)_3} + \underset{\text{Water.}}{8H_2O} + \underset{\text{Oxygen.}}{3O_2}$$

6th. From **black oxide of Manganese** and **hydric sulphate**:—

$$\underset{\text{Manganic dioxide.}}{2MnO_2} + \underset{\text{Hydric sulphate.}}{2H_2SO_4} = \underset{\text{Manganic sulphate.}}{2MnSO_4} + \underset{\text{Water.}}{2H_2O} + \underset{\text{Oxygen.}}{O_2}$$

(To be continued.)

The Practical Teacher.

A MONTHLY EDUCATIONAL JOURNAL.

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The Proposed New Class-Subject; 'Elementary Science.'

BY RICHARD BALCHIN.

THE thanks of every true educator are due to Mr. Mundella and his colleagues for those alterations in our system of popular education that tend to make the schoolmaster less of a mere instructor, and more of an intellectual trainer. Just as the spirit of the new proposals is felt and acted upon, so will the mechanical drudge of Robert Lowe vanish into extinction and the Mundella educator appear. I propose, in this article, to call the attention of my fellow-teachers to the syllabus of the new subject, which is issued, I presume, for our guidance. At first sight, the list of items included in it reminds me forcibly of the pennyworth of 'broken' I used to buy when a boy. It was a jumble of little bits of all kinds of biscuits, cakes, and stale buns, the best sort being in the smallest bits. A little further examination, however, reveals something of a plan. To make the scheme a little clearer than it looks as printed, I will give a rough analysis. The compiler of the syllabus has decided that the sciences taught shall be biology, that is, zoology and botany; natural philosophy, being for the most part what we understand as mechanics; and certain industrial operations. Under these heads, therefore, I will arrange the items of the syllabus.

Standards.	Zoology.	Botany.	Natural Philosophy.	Industrial operations.
I.	Animals.		Common objects.	
II.	Habits of domestic animals.		Colours and shapes of familiar objects.	Uses of substances employed in the arts and manufactures.
III.	Animals.	Plants.	Simple machines. Properties of air and water.	
IV.	General comparison of the chief classes of quadrupeds.		Light and heat.	Processes employed in *one* of the chief industries of England.
V.	General comparison of the chief divisions of the animal kingdom.		Gravitation, weight, specific gravities.	Processes employed in *two* of the chief industries of England.
VI.	Distribution of animals.	Distribution of plants.	Common pump. Barometer. Thermometer. Pulleys. Levers. Laws of motion.	
VII.	Races of mankind.		Construction of the steam engine. Some of ordinary chemical combinations of frequent occurrence in nature.	Application of the steam engine to agriculture and manufactures.

The points now most clearly perceived are—1st, that zoology occupies a prominent place, and that there appears the very unscientific term of classification, 'quadruped'; 2nd, that 'mechanics' is the most conspicuous subject in the syllabus; 3rd, that some of the industrial operations are to be taught on a plan; 4th, that botany is not a pet subject with the compiler.

It is very certain that this scheme must be altered before it can be made available as a guide for the teaching of elementary science. Unless this be done, I venture to say that there will not be six schools in the whole country where the new subject will be taken up. Grammar and geography will be taught as before. What will have to be done is this. A more definite syllabus must be drawn up. Then the teacher will himself arrange, from the materials therein furnished, a plan of science teaching for the year, and submit it to the inspector for his guide in examining. The plan is not to be submitted at the beginning of the year for the examiner's *approval*. For in nine cases out of ten the teacher knows much better than the inspector what is suitable for his boys. Something of this must be done, or the syllabus made more explicit. Take botany for instance. Standards I. and II. are supposed not to require any. In Standard III., botany appears. Subject: 'Plants.' But how is the teacher to know what part of the science the inspector will examine upon? To say simply 'plants' is most indefinite. After a boy has passed Standard III., he is to hear no more of plants until he reaches Standard VI.; here he is to be taught the 'distribution of plants'; then the subject is dismissed. 'If so early I am done for, what in the world was I begun for!' Well may Sir John Lubbock regret that so little prominence was given to the study of plants. I would suggest the following as the botanical part of the syllabus:—

Standard I.—To tell from pictures, leaves, and blossoms, the names of eight common trees. Most of them are now found even in London, skirting the roads. The plane, sycamore, acacia, lime, poplar, chestnut, ash, and oak.

Standard II.—The parts of a tree, or common plant, that we use, *i.e.*, root, stem, leaves, and fruit.

Standard III.—Parts of a blossom, and the functions of those parts.

Standard IV.—Each boy to form in an exercise book a collection of leaves and flowers properly named.

Standard V.—Structure and functions of root, leaves, and blossoms. Relation of insects to flowers.

Standards VI. and VII.—Each boy to form a collection of not fewer than twelve wild plants, properly pressed and named; and to be able to describe them.

From an experience of a quarter of a century of science-teaching, I have found that botany can be better taught than zoology; and for this reason. Botanical specimens are easily procured and handled. Each boy may make a collection, and may have a specimen on his desk during the lesson. He cannot very well have an animal or part of one. I do not say this is impossible. I even propose, next week, giving a lesson upon the 'tiger' and the 'cat tribe' generally; and shall invite each of the forty boys to bring his cat. I can then, during the lesson, draw attention to the form of the teeth, the structure of the claws, and the general outline of the body; each boy noting these points on his own specimen. No doubt the boys will be infinitely amused. The mere sight of forty boys with forty cats will be inexpressibly droll; and the simultaneous mewing may interrupt the logical sequence of my ideas. No such difficulty attends the teaching of botany. In the zoological part of the syllabus a certain plan is discernible, and but little alteration is needed; perhaps only in the direction of more explicitness. It must be remembered that a grant of money depends upon the result of the examination of these subjects. This being the case, it is only fair that the teacher should know clearly what is expected, and the examiner also should understand precisely what he is called upon to test.

Standard I. 'Animals.'—This is all we are told. It means, I should say, that these little Ist Standard infants are to be shown pictures of animals, to be able to name the animal when the picture is shown, and to be told interesting anecdotes about them. Here the articles (PRACTICAL TEACHER) from our old friend Mr. Wood, will suit admirably. These animals should be taken—monkey, bat, lion, whale, kangaroo, fowl, crocodile, frog, salmon, butterfly, worm, and snail.

Standard II. 'Habits of domestic animals.'—Here should be noted the characteristics that render such animals useful when domesticated.

Standard III. 'Animals.'—This again is not definite enough. I would suggest at this stage 'the division of animals into vertebrata and invertebrata, with a description of the back-bone.'

Standard IV. 'General comparison of the chief classes of Quadrupeds.'—I wonder who suggested this! Classes of quadrupeds! Why, there are none. Nobody recognises the term quadruped as distinctive of any division of the animal kingdom. It would have to include newts, bull-dogs, and salamanders; cats, cows, and crocodiles. A motley group, yet all having four feet. No; this must be struck out. I would suggest for Standard IV.—'the subdivision of the sub-kingdom vertebrata, into the classes—mammalia, birds, reptiles, amphibians, and fishes; with illustrations of each.'

Standard V.—Should deal with the subdivisions of the invertebrata.

Standard VI. 'Distribution of animals.'—This would come in with the physical geography. I would

therefore substitute 'the comparison of the classes vertebrata, as in Standard IV., but with special reference to the skeleton, the heart, and the breathing apparatus.'

Standard VII.—The law of evolution: its meaning as seen in the genesis of animals and plants. This I would substitute for the 'Races of Mankind,' which is included in physical geography.

As to the syllabus of the subjects, 'natural philosophy' and 'industrial operations,' it may stand as it is.

—o—

Publications Received.

Arithmetic—
(1) Hopkin's Pupil's Manual of Exercises in Mental Arithmetic. Osborne.
(2) Hopkin's Teacher's Manual of Exercises in Mental Arithmetic. Osborne.

Domestic Economy—
(1) Heath's Invariable Stocking Scale. Griffith and Farran,

Fiction—
(1) Kingston's Hurricane Hurry. Griffith and Farran.
(2) Kingston's Salt Water. Griffith and Farran.

French—
(1) Cassell's French-English and English-French Dictionary. Cassell and Co.
(2) Ragon's Easy and Rapid Method for learning French Verbs. Longmans.
(3) Short and Complete Exposition of the French Verbs. Stewart and Co.
(4) Goodman's French Nouns and their Genders. Simpkin, Marshall, and Co.

Geography—
(1) Blakiston's Early Glimpses. Griffith and Farran.
(2) Johnston's Types of Nations Handbook. W. and A. K. Johnston.
(3) Macdonnell's Atlas. Lewis.

Grammar—
(1) Hopkin's Orthographical Exercises. Osborne.
(2) Hopkin's Exercises in Composition. Osborne.

History—
(1) Rannie's Historical Outline of the English Constitution. Longmans.
(2) Levander's Matriculation Questions on History and Geography. Lewis.

Music—
(1) Bernhardt's Vocal Duets. Williams.

Natural History—
(1) Johnston's Natural History Plates. W. and A. K. Johnston.

Periodical Literature—
(1) Ward and Lock's Universal Instructor. Ward and Lock.

Reading Books—
(1) Murby's Imperial Reader, IV. T. Murby.

Scripture—
(1) Fleming's Notes on Exodus. T. Laurie.

School Reward Books—
(1) Holidays Abroad. Griffith and Farran.
(2) Hofer, the Tyrolese. Griffith and Farran.
(3) The Stolen Cherries. Griffith and Farran.
(4) Our Birthdays. Griffith and Farran.
(5) The Hero of Brittany. Griffith and Farran.
(6) School Days. Griffith and Farran.

Table Books—
(1) Victoria Reading Book. Hutton.

Pupil Teacher's Examination Questions.

JULY, 1881.

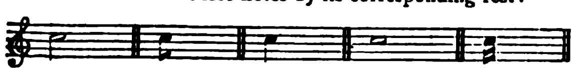
CANDIDATES.

Music.

A quarter of an hour allowed for this paper.

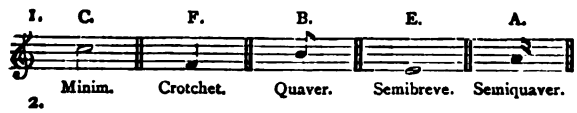
1. Write over each of the following notes its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crochet, quaver, or other):—

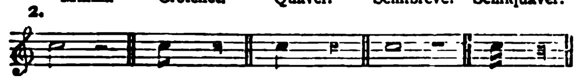
2. Follow each of these notes by its corresponding rest:—



3. How many tones and semitones are found in the major scale, and what places in it do the latter occupy?

CANDIDATES.—ANSWERS.





3. Five tones and two semitones, the latter being found between the third and fourth, and seventh and eighth notes of the scale.

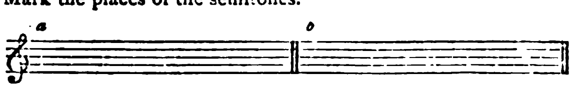
FIRST YEAR.

Pupil Teachers at end of First Year.

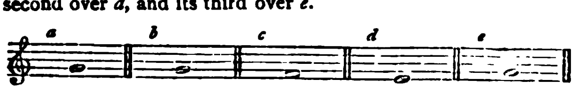
Music.

A quarter of an hour allowed for this paper.

1. Write in *a* the scale of A (*La*), and in *b* the scale of G (*Sol*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

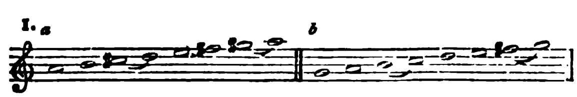


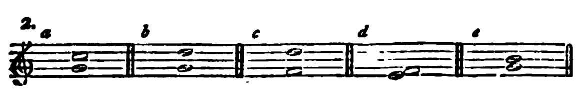
2. Place its fourth over *a*, its fifth over *b*, its sixth over *c*, its second over *d*, and its third over *e*.



3. How many crotchets are equal (in length) to a dotted semibreve?
How many quavers are equal (in length) to a dotted minim?
How many semiquavers are equal (in length) to a crotchet?

ANSWERS.—FIRST YEAR.





3. Six.
Six.
Four.

SECOND YEAR.

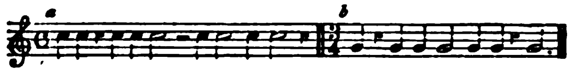
Pupil Teachers at end of Second Year.

Music.

A quarter of an hour allowed for this paper.

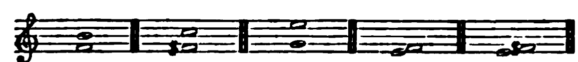
1. Write under each of the following, the name and quality (major, perfect, or other) of the interval it forms :—

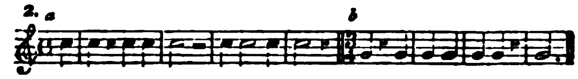
2. Divide (by bars) the notes in *a* into measures of common time ; those in *b* into measures of triple.



3. Write in *a* the signature of F (*Fa*), in *b* that of G (*Sol*), in *c* that of D (*Re*), and in *d* that of B♭ (*Se*).

ANSWERS.—SECOND YEAR.





THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May, 1878*; and Pupil Teachers at end of Fourth Year, if apprenticed before that date.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. Find the simple interest on £1,245 for 15 years at 4½ per cent. per annum ; and the amount of £1,158, 17s. 6d. for 1 year 115 days at £2, 10s. per cent. per annum.

2. By selling a yacht for £994, 10s. I gain 17 per cent. on its cost price ; what should I have received for the yacht if my *loss* had been 17 per cent.

3. If an innkeeper sells three-fifths of a barrel of beer for what the whole cost him, viz., 30s., and the remainder at the same rate of profit ; what is his gain (*a*) per cent.? and (*b*) per gallon?

4. How is 'discount' calculated in trade? Which party has the advantage? What is meant by 'days of grace,' 'bills payable at sight'?

FEMALES.

1. Simplify the expressions :—
   (*a*) 5—3·22+2·333—1·444.
   (*b*) 75·012—7·50123+·7501234—·075012345.

2. Express ·375 of a guinea + $\frac{2}{15}$ of a crown + ·3 of 7s. 6d.—$\frac{3}{8}$ of 2d., as the decimal of 16s.

3. If 8 oz. of sugar be worth ·5625s., what is the value of ·75 of a ton?

Grammar.

1. 'As *one*, *that* museth, *where* broad sunshine laves
The lawn by some cathedral, thro' the door
Hearing the holy organ *rolling* waves
Of sound, on roof and floor
Within, and anthem *sung*, is *charmed*, and tied
To where he stands,—so stood I.'—TENNYSON.

(*a*) Point out the principal and the various subordinate sentences in the above, describing the character of each.

(*b*) Point out any extension of the subject that you notice in the above, and show of which subject it is an extension.

(*c*) Parse the words in italics

2. What are the Latin prepositions that signify *under and across?* Give examples of words compounded from them, and show how, in some cases, they are changed in composition.

Geography.

Answer *either* Q. 2 *or* Q. 3, *not both.*

1. Give notes of a lesson to a Second Standard on *Peninsulas, Islands*, and *Straits* ; and illustrate your lesson by reference to a map of the 'Malay Archipelago.'

2. Describe the physical features of Turkey in Asia.

3. Name the States which lie on the northern shores of Africa, and say what you know about each of them.

One hour allowed for Females, two and a half for Males.

History.

1. What led the Protector Somerset to invade Scotland? What was the result of his expedition?

2. What forms of taxation were employed by James I. and Charles I., which excited resistance on the ground of illegality?

3. What induced England to engage in the French war of 1793?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Elementary*.

Write, in small hand, as a specimen of copy-setting, '*Example and practice are more efficient than precept and theory.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation*, such as —, +, ×, are not admissible.]

1. To draw a straight line through a given point parallel to a given straight line.

Through two given points draw two lines forming with a line given in position an equilateral triangle.

2. In any right-angled triangle, the square which is described upon the side subtending the right angle is equal to the squares described upon the sides which contain the right angle.

Algebra.

1. Divide $x^4 - \frac{3}{2}x^3 + \frac{11}{8}x^2 - \frac{1}{2}x$ by $x^2 - \frac{1}{2}x$.

2. Find the value of $am + bn$ when $m = \dfrac{ck - bl}{ak - br}$ $n = \dfrac{al - cr}{ak - br}$.

3. Solve :—

$$(1)\ \frac{17x}{39} - \frac{3}{52} = 1 - \left(\frac{12}{13} - \frac{11x}{26}\right)$$

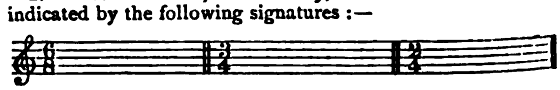
$$(2)\ \frac{30 + 6x}{x + 1} + \frac{60 + 8x}{x + 3} = 14 + \frac{48}{x + 1}$$

Music.

A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of D (*Re*). Mark the places of the semitones :—

2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures :—



3. Write over each of the following the name of the major scale, and under each that of the minor scale, of which it is the signature :—

ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. (*a*) Interest $= £1245 \times 15 \times \frac{4\frac{3}{4}}{100} = £1245 \times \frac{15 \times 19}{400} =$

$£\frac{1245 \times 57}{80} = £\frac{70965}{80} = £887$ 1s. 3d. Ans.

(*b*) £1158 17s. 6d. = £1158·875

Interest $= £1158{\cdot}875 \times \frac{480}{365} \times \frac{2\frac{1}{2}}{100} = £1158{\cdot}875 \times \frac{12}{365} =$

$£\frac{13906{\cdot}5}{365} = £38$ 2s.

∴ amt. = £1158 17s. 6d. + £38 2s. = £1196 19s. 6d. Ans.

2. 117 : 83 :: £994½ : x.

$£\frac{1989}{2} \times \frac{83}{117} = £\frac{17 \times 83}{2} = £705$ 10s. Ans.

3. 3 parts gain 2

∴ 100 " " $\frac{2 \times 100}{3}$ *i.e.* 66⅔ p. c. Ans.

A gain of 66⅔ p. c. on 30s. = 30s. × $\frac{500}{300}$ = 50s.

∴ the gain per gallon = 20s. ÷ 36 galls. (barrel of beer).
= 6⅔d. Ans.

4. In discounting bills, bankers and merchants calculate *interest* instead of discount, on the sum drawn for in the bill, from the date of their discounting it to the time when it becomes due. *This discount* is greater than the *true discount* by the interest on the latter for the time that the bill has still to run. They add also *three days of grace*, which days are allowed after the bill is *nominally* due before it is *legally* due; which is an additional advantage. Days of grace are not allowed, when the bill is payable at sight, *i.e.* on presentation.

FEMALES.

1.

(*a*)	(*b*)
5	75·012
− 3·22	− 7·50123
1·78	67·51077
+ 2·333	+ ·7501234
4·113	68·2608934
− 1·444	− ·075012345
2·669. Ans.	68·185881055. Ans.

2.

	s.
·375 of 21s. =	7·875
$\frac{3}{16}$ of 5s. =	·9375
·3 of 7s. 6d. =	2·25
− ⅛ of ½s. =	− ·0625
	11

∴ 11s. to the dec. of 16s. = $\frac{11}{16}$ = ·6875. Ans.

3. 8 oz. : ·75 ton :: ·5625s. : x.
or ·5 lb. : 1680 lb. :: 6¾d. : x.

$\frac{27}{4}\text{d.} \times \frac{1680}{\cdot 5} = £\frac{27 \times 1680}{2 \times 12 \times 20} = £94$ 10s.

Grammar.

1. (*a*) 1. 'As one thro' the door hearing the holy organ rolling waves of sound on roof and floor within an anthem sung is charmed.'—*subordinate adverbial sent. to* (6).
   2. 'As one etc. *same as* 1. is tied.'—*subord. adv. sent. to* (6).
   3. 'that museth.'—*subord. adj. sent to* 'one' (2).
   4. 'Where broad sunshine laves the lawn by some cathedral.'—*subord. adv. sent. to* (3).
   5. 'to where he stands.'—subord. adv. sent. to (1). and (2).
   6. So stood I.—*principal sent.*

(*b*) '*thro' the door hearing . . . . . . and anthem sung*' is an extension of the subject '*one.*'

(*c*) *one*—indef. pron., 3rd pers. sing., mas., nom. to *is charmed.*
that—simple rela. pron. referring to *one*, 3rd pers. sing., nom. to *museth.*
where—rel. adv. modifying *laves* and connecting '*the sunshine laves, etc.*,' with *that museth.*
hearing—incomplete part of the reg. verb *hear* qualifying *one.*
rolling—incomplete part of the reg. verb. *roll* qual. *organ*
within—adverb modifying *rolling.*
sung—complete part of irreg. verb *sing, sang, sung,* qual. *anthem.*
charmed—complete part. qual. and referring to *one.*
to—prep. gov. obj. case (*place*) or the phrase *where he stands.*
where—rel. adverb introducing subordinate sent. *he stands.*

2. *Sub* signifies 'under' and also takes in composition the forms suc, suf, sug, sum, sup, sur, sus: as *sub*ject, *suc*ceed, *suf*fix, *sug*gest, *sum*mon, *sup*pl·nt, *sur*rogate, *sus*ceptible.
Trans takes the forms tran, tra; as *tran*sact, *tran*scend, *tra*duce.

Geography.

1. *Peninsula* (*pene* almost *insula* an island) a long stretch of land jutting out into the sea—nearly surrounded by water—the *neck* joining it to the mainland being often called an *isthmus.*—Compare the human head to the peninsula and the neck to an isthmus.
Island.—Land entirely surrounded by water—occupies the same relation to the sea that a lake does to the land.
Straits.—Narrow passage of water connecting two seas—compare with the isthmus which connects two portions of land—a strait easily fathomed called a *Sound* and *Channel.*

2. Turkey in Asia has lofty mountains in the N. and W., with elevated plateaux, and some fertile valleys—in the S.E. stony or sandy plains with tracts of rich alluvial soil, subject to inundations. Syria is traversed by the two ridges of Lebanon through its whole extent. The Armenian mountains are in the N.E. and mountains of Taurus between the Black sea and the Levant.
The chief rivers are the Euphrates, Tigris, which unite before falling into the Persian Gulf, the Jekel-Irmak, the Kizil-Irmak, and the Sakaria into the Black Sea, and the Sarabat and Meander into the Archipelago. The Orontes falls into the Levant.

3. The states which lie on the nothern shores of Africa are :—
(1) *Egypt*, one of the most remarkable countries in the world for its history, stupendous monuments, and singular physical character. The whole of the Delta of the Nile is under water from July to September. Its capital is Cairo, the finest city in Africa. (2) *States of Barbary* include (*a*) *Tripoli* which presents all the desolation of the desert. (*b*) *Tunis* at present embroiled with France—governed by a Bey—its capital, Tunis, is the most commercial city of Barbary. (*c*) *Algeria*, a very fertile region belonging to France—Algerines formerly notorious for piracy—formerly governed by a Dey. (*d*) *Morocco*, a well-watered and fertile region traversed by the *Atlas* mountains—governed by an Emperor or Sultan.

History.

1. The Protector Somerset was led to invade Scotland for the purpose of bringing about a marriage between Edward VI. and the young Queen of Scots. This was a favourite arrangement of Henry VIII. The defeat of the Scots at Pinkie, in 1547, did not make them more willing to agree, but caused them to send Mary to France, where she was brought up and in due time married to the Dauphin.

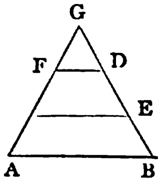
2. The illegal forms of taxation resorted to by James I. and Charles I. were 'the imposition of Customs duties on almost all kinds of merchandise imported or exported;' 'demanding benevolences or loans;' 'abuse of wardship;' 'quartering soldiers on citizens;' 'causing knighthood on the landed gentry for the sake of causing them to compound for the refusal of it;' 'exaction of large sums from landowners for encroaching on Crown lands;' 'fining the citizens of London for breach of an illegal proclamation, forbidding the extension of the city;' 'fining Catholics for "recusancy;"' 'monopolies;' 'purveyance;' and 'ship-money.'

3. Pitt who was at the head of affairs was very averse to engage in a war with France, unless the latter violated the independence of her neighbours. On the execution of Louis, however, all ties with the monarchies of Europe were severed. Diplomatic communications were broken off, and in February, 1793, France issued her Declaration of War.

Euclid.

1. Prop. 31, Bk. I.
RIDER.—Let CD be the two points, and AB the line given

in position. Through C and D draw CE, DF parallel to AB, and at the points C in CE and D in DF respectively make the angles ECF, GDF, each equal to the angle of an equilateral triangle. Produce the lines CF, DE both ways to meet one another in G, and the given line in A, and B, then AGB is the equilateral triangle required.



The angles FCE, FDG, are equal respectively to CAB and EBA, because the lines CE, DF are parallel to AB. Therefore the two angles at the base AB are each the angle of an equilateral triangle, viz. two-thirds of a right angle, and so the remaining angle at G must be two-thirds of a right angle. Since the three angles = two right-angles, and since the triangle is equiangular, it must also be equilateral.—Q.E.F.

2. Prop. 47, Bk. I.

Algebra.

1.
$$x^2-\tfrac{1}{2}x)\,x^4-\tfrac{5}{4}x^3+\tfrac{11}{8}x^2-\tfrac{1}{2}x\,(x^2-\tfrac{3}{4}x+1$$
$$\begin{array}{r} \underline{x^4-\tfrac{1}{2}x^3} \\ -\tfrac{3}{4}x^3+\tfrac{11}{8}x^2 \\ \underline{-\tfrac{3}{4}x^3+\tfrac{3}{8}x^2} \\ x^2-\tfrac{1}{2}x \\ \underline{x^2-\tfrac{1}{2}x} \end{array}$$

2. Substituting for m and n, the expression becomes
$$\frac{ack-abl+abl-bcr}{ak-br}=\frac{c(ak-br)}{ak-br}=c \text{ Ans.}$$

3. (1) Multiplying both sides of equation by 156, we obtain
$$68x-9=156-144+66x$$
$$68x-66x=156+9-144$$
$$2x=21$$
$$x=10\tfrac{1}{2} \text{ Ans.}$$

(2)
$$\frac{60+8x}{x+3}=\frac{14x+62-30-6x}{x+1}$$
$$\frac{60+8x}{x+3}=\frac{8x+32}{x+1}$$
$$60x+8x^2+60+8x=8x^2+32x+24x+96$$
$$8x^2-8x^2+68x-56x=96-60$$
$$12x=36$$
$$x=3 \text{ Ans.}$$

Music.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May,* 1878; **and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. A. invests £457 10s. 0d. at compound interest for 3 years at 4 per cent. B. invests £477 10s. 0d. at simple interest for the same time, and at the same rate. How much more does one receive than the other?

2. If the American dollar is worth four shillings and twopence, and the "cent" = the hundredth part of the dollar, find, in English currency, the simple interest on 3,689 dols. 45c., at 7 per cent. for four years and seven months.

3. When the 3 per cents. Consols are at 89⅞, what must be the price of the India 5 per cents. in order that the same income may be realised after transferring by investment from the former to the latter, ⅛ per cent. brokerage being charged both on the sale and purchase of the stock?

4. A market-woman bought a number of ducks at 2s. each, and three-fifths of that number at 3s. each. She sold the whole lot at 5s. a pair, and gained £4 10s. 0d. by her bargain. Find how many of each kind of ducks she bought, and her gain per cent.

5. A servant puts into the savings bank £2 15s. 0d. on the last day of each quarter. Calculate the amount due to him directly after 12 such payments, simple interest being allowed at the rate of ½d. per calendar month for each complete pound, and payable only on the withdrawal of the account.

FEMALES.

1. A man spends on an average 30 guineas a fortnight; what must be his daily income in order that with his savings at the end of 3½ years he may buy an estate worth, £1,719 18s. (supposing a year to consist of 52 weeks).

2. If 5 men, on a tour of 11 months, spend £641 13s. 4d., how much at the same rate would it cost a party of 7 men for 4 months?

3. Find the amount of £237 10s. in 2 years, 8 months, 29 days, at 5 per cent. simple interest.

4. A ream of paper costs 21s. 6d.; what must it be sold for to realise 20 per cent.?

Grammar.

1. 'The first Remedy is to remove by all meanes possible, that *materiall* cause of sedition, *whereof* we spake; which is Want and Poverty in the Estate. To which purpose *serveth* the Opening, and well Balancing of Trade; the *Cherishing* of Manufactures; the *Banishing of Idlenesse; the Improvement and Husbanding of the Soyle;* the regulating of Prices of things *vendible;* the *Moderating* of *Taxes* and *Tributes;* and the like.'

Lord Bacon's Essay on Sedition and Troubles.

(*a.*) Prove that the participles made use of in the above passage are verbal nouns; and give instances to show that the same participles may be sometimes used as adjectives, and sometimes as nouns.

(*b.*) Analyse from '*The first Remedy*' to '*in the Estate.*'

(*c.*) To what period does the above passage belong? In what respects does it seem to you to differ from the English of the present day?

(*d.*) Give the meaning of the words and phrases in italics.

Geography.

Answer *either Q.* 2 *or Q.* 3, *not both.*

1. Give notes of a lesson to a Second Standard on *Peninsulas, Islands,* and *Straits*; and illustrate your lesson by reference to a map of the 'Malay Archipelago.'

2. Describe fully the basin of the Mississippi.

3. Say what you know about the Arctic Ocean and the expeditions to find a passage through it.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. Compare the social condition of the English people at the beginning and at the end of the fourteenth century.

2. Give some account of Strafford's government in Ireland. Describe his end.

3. At the end of Queen Anne's reign what chance was there of the continuance of the Stuarts upon the throne?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Elementary.*

Write, in small hand, as a specimen of copy-setting, '*Example and practice are more efficient than precept and theory.*'

Composition.

Write a short essay on *The Use of Railways.*

Euclid.

The only abbreviations admitted for '*the square on A B*' is '*sq. on A B,*' and for '*the rectangle contained by A B and C D,*' '*rect. A B, C D.*']

1. If a straight line be divided into two equal parts, and also into two unequal parts; the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

AD is drawn from the vertex of an isosceles triangle to any point D in the base BC. Show that the difference of the squares on AB, AD is equal to the rectangle contained by BD, CD.

2. To describe a square that shall be equal to a given rectilineal figure.

Algebra.

1. Find the square root of—

$$x^4 - 2x^3 + \frac{3x^2}{2} - \frac{x}{2} + \tfrac{1}{16}.$$

2. Find the G.C.M. of $3x^4+14x^3+9x+2$ and $2x^4+9x^3+14x+3$.

3. Solve—

$$(1)\begin{cases}\dfrac{x+11}{10}+\dfrac{y-4}{6}=x-7\\[2mm] \dfrac{x+5}{7}-\dfrac{y-7}{3}=3y-x\end{cases}$$

$$(2)\quad \frac{12}{5-x}-\frac{8}{x-4}=\frac{32}{x+2}$$

Mensuration.

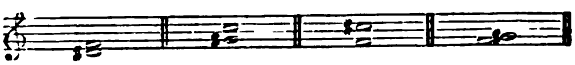
1. The inner diameter of a circular building is $68\frac{5}{8}$ feet, and the thickness of the wall is $1\frac{5}{8}$ feet; how many square feet does the base of the wall occupy?

Music.

A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of A (*La*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.

2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms:—



3. Write the following, at the same pitch, on the treble stave:—

ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. (*a*) 4 p. c. gives $\frac{1}{25}$ of principal per annum.

```
£457·5
  18·3
------
 475·8   amt. end of 1st year.
  19·032
--------
 494·832   ,,   2nd  ,,
  19·79328
----------
 514·62528 ,,   3rd  ,,
 457·5        principal.
----------
£57·12528 = compound interest.
```

(*b*) $£477·5 \times 3 \times \frac{4}{100} = £4·775 \times 12$
$= £57·3$ simple int.

```
                         57·12528 comp. int.
diff. in favour of (b)    ·17472
                              20
                          3·4944s.
                              12
                          5·9328
```

∴ B gets 3s. 5·9d. more than A.

2. Interest on 3689·45 dols. at 7 p. c. for $4\frac{7}{12}$ years $= 3689·45 \times \frac{55}{12} \times \frac{7}{100} = 36·8945 \times \frac{385}{12} = \frac{14204·3825}{12} = 1183·6985416$ dols. at 4s. 2d. each.

```
3s. 4d. = 1/6 of £      | 1183·6985416
                        |  197·28309027
10d. = 1/4 of 3s. 4d.   |   49·3207725694
                      £ |  246·6038628472
                                      20
                           12·07725694s.
                                      12
                            0·9270833d.
                                      4
                            3·7083
```

∴ £246 12s. $0\frac{3}{4}\frac{17}{24}$f. Ans.

3. In selling out of the 3 per cents. he gets only $89\frac{1}{4}$ p. c.
∴ £3 : £5 :: £$89\frac{1}{4}$: x (price of Indian, per cent.).
£$\frac{357}{4} \times \frac{5}{3} = \frac{595}{4}$ = £$148\frac{3}{4}$ price of Indian stock to get same income as the 3 per cents. at $89\frac{1}{4}$.
£$148\frac{3}{4}$ − $\frac{1}{8}$ for brokerage = £$148\frac{5}{8}$. Ans.

4. The ratio of the two kinds is 5 : 3
,, ,, prices is 2s. : 3s.
,, value of each lot is 10 : 9
∴ value of 8 ducks of both kinds = 19s.
,, 2 ,, ,, = $4\frac{3}{4}$s.
But selling the whole at 5s. per pair, there is a gain of 5s. − $4\frac{3}{4}$s., or $\frac{1}{4}$s.
The gain on the whole = 90s.
∴ if 2 gain 3d., then the number required to gain 1080d. will be $\frac{2 \times 1080}{3}$ or 720 ducks.
∴ $\frac{5}{8}$ of 720 = 450 at 2s. Ans.
and $\frac{3}{8}$ of 720 = 270 at 3s. Ans.
The gain = $\frac{1}{4}$s. on $4\frac{3}{4}$s. = $\frac{1}{19}$ of whole, or $\frac{100}{19}$ p. c. = $5\frac{5}{19}$. Ans

5.

£	s.		d.
2	15	for 3 mos. at ½ per £	3
5	10		$7\frac{1}{2}$
8	5		12
11	0		$16\frac{1}{2}$
13	15	,, ,,	$19\frac{1}{2}$
16	10		24
19	5		$28\frac{1}{2}$
22	0		33
24	15	,, ,,	36
27	10		$40\frac{1}{2}$
30	5		45
			$265\frac{1}{2}$ = £1 2s. $1\frac{1}{2}$d.

∴ the exact sum to be paid after the 12th payment is £33 + £1 2s. $1\frac{1}{2}$d. or £34 2s. $1\frac{1}{2}$d. Ans.

FEMALES.

1. (*a*) $\frac{30 \text{ gui.}}{14} = \frac{£31\ 10s.}{2 \times 7}$ = £2 5s. spent per day.

(*b*) $\frac{£1719\ 18s.}{52 \times 3\frac{1}{2} \times 7} = \frac{(£245\ 14s.) \times 2}{13 \times 4 \times 7} = \frac{£35\ 2s.}{26}$
= £1 7s. saved daily.
∴ he must have a daily income of £1 7s. + £2 5s., or £3 12s. Ans.

2. $\left.\begin{matrix}5 \text{ men} : 7 \text{ men}\\ 11 \text{ mo.} : 4 \text{ mo.}\end{matrix}\right\}$ :: £$641\frac{2}{3}$: x

£$\frac{1925}{3} \times \frac{7}{5} \times \frac{4}{11}$ = £$\frac{35 \times 7 \times 4}{3}$ = £326 13s. 4d. Ans.

3. 2 yrs. 8 mo. 29 days = $\frac{8}{3}$ yrs. + 29 days = $1002\frac{1}{3}$ days. (?)
Interest of £237·5 for $1002\frac{1}{3}$ days at 5 p. c. = £237·5 × $\frac{3007}{1095}$ × $\frac{5}{100}$ = £2·375 × $\frac{3007}{219}$ = £32 12s. $2\frac{32}{73}$d. Ans.
∴ amt. = £270 2s. $2\frac{32}{73}$d. Ans.

4. £100 : 21s. 6d. :: £120 : x (pounds).
£120 × $\frac{43}{4000}$ = £$\frac{129}{100}$ = £1 5s. $9\frac{3}{5}$d.

Grammar.

1. (*a*) The participles made use of in the passage are verbal nouns, from their taking the article before them and 'of' (preposition) after them.

The following are examples of participles and nouns:—

Participles.	*Nouns.*
A man, *moving* a stone.	The *moving* of the stone.
Going abroad, we sailed.	We waited for his *going*.
Then thundering as he came.	They heard the thundering of hoofs.

(b)

Kind of Sentence.	Subject.	Predicate.	Completion.	Extension.
Principal	The first remedy	is to remove	that materiall cause of sedition	by a l meanes possible.
Adjective	we	spake	whereof (*also connective*)	
Adjective.	which	is (*incomplete*)	Want and Poverty in the estate	

(c) The passage belongs to that period of English literature called the 'Modern' or 'Age of Elizabeth' (1575-1616). It differs from the English of the present in idiom, spelling, and the meaning of individual words, *e.g.*, '*whereof we spake;*' '*to which purpose serveth;*' *materiall* for *material*, *mean*'s for *means*, *idlenesse*, *soyle*, for *idleness* and *soil*; *estate* for *state*, etc.

(d) *materiall* means *very important.*
whereof means *of which*
serveth means *is of use to, assists*
Cherishing means *fostering*
Banishing of idlenesse means *seeing that all are employed.*
Improvement and husbanding of the soyle means *improving and tilling or cultivating the soil*
vendible means *for sale*
moderating Taxes and Tributes means *regulating taxes and money levied, so as not to be excessive.*

Geography.

1. See same question answered under *Third Year.*

2. The *Mississippi* rises in L. Itasca at an elevation of 3,000 feet. It receives the St. Peter's River, and continues south, receiving in succession the *Wisconsin, Iowa, Des Moines*, and *Illinois*, before it is joined by the *Missouri*, which, rising about the same parallel as the Mississippi, unites with its tributary the *Yellowstone.* The united stream flows S.E., receiving the *Platte*, the *Kansas*, and the *Osage.* At the junction of the Missouri and Mississippi the streams are about half-a-mile wide, and, with the same width, the combined stream rushes on till joined by the *Ohio*, which rises in the Apalachian Mts, and has for branches the *Wabash, Cumberland*, and *Tennessee.* The main river is joined by the *Arkansas* on the right bank, flows on south to be augmented by the waters of the *Red River*, after which it enters the Gulf of Mexico. The area of its basin is estimated at a million and a quarter square miles. The principal towns are *Iowa, Jefferson, St. Louis, Pittsburg, Cincinnati, Natches*, and *New Orleans.*

3. The Arctic Ocean, comprising the whole water-area within the Arctic Circle, is almost completely closed by the northern coasts of the Old and New Worlds. It is nearly circular in form, and communicates with the Pacific by Behring's Strait, and with the Atlantic by Davis Strait and the wide channel between Greenland and Norway. The best known of its land-masses are Greenland, Nova Zembla, Spitzbergen, and the north coasts of Siberia and America. This ocean was early brought into prominence by the attempts made to find a 'North-West Passage' to India, and by the numerous attempts which have been made to reach the Pole. To achieve the former, Sir John Franklin and Sir Edward Parry explored far into the Arctic regions. Franklin's last expedition was made in 1845, and from this neither he nor his companions ever returned. After several expeditions under different leaders in search of him, in the course of which at least three North-West passages have been discovered, Captain McClintock found in 1857 a paper left at Point Victory recording the death of Franklin in 1847. In 1875, the *Alert* and *Discovery* were sent out under Captain Nares, and a point 400 miles from the Pole—the highest point yet reached—was attained. The Dutch, German, American, and other Governments have also contributed much to Arctic discovery. A *North-East* passage has lately been made by Nordenskiold in the *Vega.*

History.

1. With the death of Richard II. closed the fourteenth century, during which England made great steps towards civilization. At the beginning of the century the people had just become fused into one, and all, from the greater barons to the villeins, were considered equal in the eye of the law. This accounts for the readiness with which all classes united during the century against the encroachments of the Crown. Under the Edwards there was a great growth of constitutional liberty, and of freedom in the administration of justice. Though at the end of the century villeinage had not been finally abolished, yet it had been greatly mitigated, and the doctrine of man's right to personal freedom was all but established. During this period two classes had been quietly asserting their power, and these were a new order of *tenant farmers*, who were connected with Tyler's agrarian revolt, and the *craftsmen*, in towns, who won great privileges from the older burghers. These two classes quietly changed the whole character of English society.

2. In Ireland, Strafford delivered by his strict government the mass of the people from a hundred masters, that is, he freed them from the terrors of landlordism. Justice was enforced, outrage repressed, the condition of the clergy improved, and the sea cleared of pirates. But his good government had other ends. He practised his system of 'Thorough' for the purpose of supporting the arbitrary government of Charles I., and from his subservient parliament he obtained the means of keeping up an army of 5,000 foot and 500 horse. For furthering his designs he set Protestant against Catholic, in order that both might be dependent on the protection of the Crown. He has the credit of originating the linen trade of Ireland by introducing the growing of flax. His career was cut short by the Long Parliament, which, in its first session, passed a bill of Attainder against him for treason against the liberties of the people. Charles left his faithful servant to his fate—a weakness for which he ever after accused himself. Strafford was executed 1641.

3. The last year of Anne's reign was occupied with Jacobite intrigues on behalf of the Pretender calling himself James III., and to whose succession the Queen herself is said to have been favourable. Lords Oxford, Bolingbroke, and Ormond were impeached by the Commons for high treason, but the last two fled to the Continent. The Pretender arrived in Scotland after the defeat and surrender of Lords Derwentwater, Nithisdale, Wintoun, and Kenmure (1715). He and his general, the Earl of Mar, did nothing but slink away to St. Germains. By the Triple Alliance the Pretender lost the support of France and Holland. Another attempt in 1745 by the Young Pretender ended in the disastrous defeat at Culloden, after which the Stuart cause perished.

Composition.

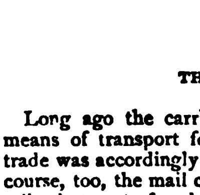
THE USE OF RAILWAYS.

Long ago the carrier's cart or the canal-boat were the only means of transport for the manufactures of the country, and trade was accordingly very much hampered. For personal intercourse, too, the mail coach, moving at the rate of two hundred miles in twenty-four hours, was totally inadequate. By means of railways, however, commercial intercourse is now freed from the restraints laid upon it by insufficient means of transport. This is abundantly proved by the millions of tons of goods carried from the places of production to those where they are consumed. By the use of railways a fondness for travel has been raised among the people. In coaching days men had scarcely time or money to spend on a long journey, and so they confined their travels to visiting, on foot, places and persons within easy distance of home. From this reason society was naturally divided into multitudes of little clans, mutually jealous of, and unacquainted with, each other. However when the cause of separation was removed men of different places met more frequently, commercial intercourse extended, errors of opinion were corrected, and the nation became more united and assimilated in language, manners, and customs.

Euclid.

1. Prop. 5, bk. 2.

Rider.—From A let fall AE perpendicular to BC. Then BE=EC for $AB^2=AC^2=AE^2+BE^2$ or AE^2+EC^2. Take away the common square on AE, and $BE^2=EC^2$ or BE=EC.



Again, $AB^2=BE^2+AE^2$
$=BD{\cdot}DC+\overline{DE^2+AE^2}$
$=BD{\cdot}DC+\overline{AD^2}$

that is, AB^2 is greater than AD^2 by the rectangle BD·DC.—Q.E.D.

2. Prop. 14, bk. 2.

Algebra.

1.

$$\begin{array}{r|l} x^2 & x^4 - 2x^3 + \frac{3x^2}{2} - \frac{x}{2} + \frac{1}{16}\,(x^2 - x + \frac{1}{4} \\ & \underline{x^4} \\ 2x^2 - x & \quad - 2x^3 + \frac{3x^2}{2} \\ & \quad \underline{- 2x^3 + x^2} \\ 2x^2 - 2x + \frac{1}{4} & \qquad\qquad \frac{1}{2}x^2 - \frac{x}{2} + \frac{1}{16} \\ & \qquad\qquad \frac{1}{2}x^2 - \frac{x}{2} + \frac{1}{16} \end{array}$$

2.

$$2x^4 + 9x^3 + 14x + 3)\,6x^4 + 28x^3 + 18x + 4\,(3$$
$$\underline{6x^4 + 27x^3 + 42x + 9}$$
$$x^3 - 24x - 5)\,2x^4 + 9x^3 + 14x + 3\,(2x + 9$$
$$\underline{2x^4 - 48x^2 - 10x}$$
$$9x^3 + 48x^2 + 24x + 3$$
$$\underline{9x^3 \qquad - 216x - 45}$$
$$48 \mid 48x^2 + 240x + 48$$
$$\underline{x^2 + 5x + 1}$$

$$x^2 + 5x + 1)\,x^3 - 24x - 5\,(x - 5$$
$$\underline{x^3 + 5x^2 + x}$$
$$- 5x^2 - 25x - 5$$
$$\underline{- 5x^2 - 25x - 5}$$
$$\therefore x^2 + 5x + 1 = \text{G.C.M.}$$

3.

$(a)\ \frac{x+11}{10} + \frac{y-4}{6} = x - 7$ or $(a)\ 3x + 22 + 5y - 20 = 30x - 210$

$(b)\ \frac{x+5}{7} - \frac{y-7}{3} = 3y - x$ or $(b)\ 3x + 15 - 7y + 49 = 63y - 21x$

After collecting $(a) = 27x - 5y = 223$ or $378x - 70y = 3132$

$(b) = 24x - 70y = -64$ or $\underline{24x - 70y = -64}$

$354x = 3196$

$x = 9$

and by substitution $y = 4$

2. $\frac{12}{5-x} - \frac{8}{x-4} = \frac{32}{x+2}$

Reducing $3x^2 - 6x - 24 - 20 - 6x + 2x^2 = 72x - 8x^2 - 160$

arranging and collecting $13x^2 - 84x = -116$

$x^2 - \frac{84}{13}x = -\frac{116}{13}$

Completing sq. $x^2 - \frac{84}{13}x + \frac{1764}{169} = \frac{1764 - 1508}{169} = \frac{256}{169}$

taking root $x - \frac{42}{13} = \pm \frac{16}{13}$

$x = \frac{42}{13} \pm \frac{16}{13} = 4\frac{6}{13}$ or 2. Ans.

Mensuration.

Diameter of inner circle $= 68\frac{5}{6}$ ft.

,, ,, outer ,, $= 68\frac{5}{6} + 1\frac{5}{6} + 1\frac{5}{6} = 72\frac{1}{2}$ ft.

$\therefore$ required area $= 141\frac{1}{3}$ sum of diam. $\times\ 3\frac{2}{3}$ diff. of diam. $\times\ \cdot7854$

$\frac{424}{3} \times \frac{11}{3} \times \cdot7854 = 518\frac{2}{9} \times \cdot7854 = 407\cdot01173$ sq. ft. Ans.

Music.

AUGUST, 1881.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the value of 7 lbs. 6 oz. 7 drms. 2 scru. 7 grs. at £1 per oz.

2. What is the total cost of 15,378 articles at £7 19s. 8¾d. each?

3. If £22 10s. will purchase 3 cwt. 24 lbs. of coffee, what quantity should be procurable for £75?

4. The rent of a farm of 42 ac. 1 rd. is £158 8s. 9d., what could 39 ac. 2 roods 20 poles be rented for at the same rate?

5. 2 rabbits are worth 1s. 5d.; 3 hares, 10s. 7½d.; how many score of rabbits would be equal in value to 13½ dozen hares?

FEMALES.

1. Make out the following bill:—

21 lbs. of candles at 7½d. per lb.
45 ,, of sugar at 4¼d. ,,
25½ ,, of plums at 6½d. ,,
2¼ ,, of tea at 2d. per oz.
10 ,, 14 oz. of rice at 4d. per lb.

2. Find the cost of 7,845 articles at £26 14s. 8¾d. each.

3. 7,985⅝ at £8 19s. 4½d. each.

4. What is the value of 90 qrs. 0 bush. 1 pk. at £7 11s. 4d. per qr.?

Grammar.

1.
'Down sank the disappearing band;
Each warrior vanished where he stood,
In broom, or bracken, heath, or wood:
It seemed as if their mother earth
Had swallowed up her warlike birth.'—SCOTT.

Parse all the verbs, adjectives, and words used as adjectives in the above.

2. Show how the possessive case of nouns is formed, both in the singular and plural numbers, and give examples.

3. Give the past tense of the indicative mood of the verbs *do, dare, can, shall.*

Geography.

Answer *two questions.*

1. Trace as minutely as you can, the course of the River Severn; showing as you proceed how it supplies you with examples of the meaning of each of these terms—viz.:—

Affluent, City, Confluence, Estuary, Mountain, Plain, Source, Tide, Valley, Watershed.

N.B.—These terms are here arranged alphabetically. You are to mention each example, and explain each term *in its proper order.*

2. Describe the course of a vessel sailing from Belfast to Queenstown. Or, *if you can,* draw a map of the coast-line.

3. Say what you know about Inverness, Skye, Stafford, the Solway Firth, Scarborough, Yarmouth, St. Albans, and Maidstone.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

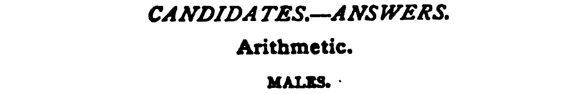
Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible.*

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act,* 1875.

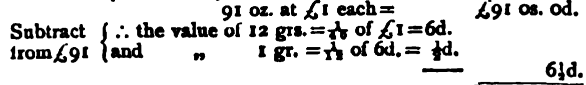
Music.

A quarter of an hour allowed for this paper.

1. Write over each of the following notes its pitch name (C, D, *Do, Re,* or other), and under each its duration name (crochet, quaver, or other).



2. Follow each of these notes by its corresponding rest.



3. How many tones and semitones are found in a major scale, and what places therein do the latter occupy?

CANDIDATES.—ANSWERS.

Arithmetic.

MALES.

1. 7 lbs. 6 oz. 7 drs. 2 scr. 7 grs. = 91 oz. − 13 grs.

91 oz. at £1 each = £91 0s. 0d.

Subtract from £91 { ∴ the value of 12 grs. = $\frac{1}{40}$ of £1 = 6d.
and ,, 1 gr. = $\frac{1}{12}$ of 6d. = ½d.

6½d.

£90 19s. 5½d.

2.

		£	s.	d.		
		15378	0	0		
				7		
s.	d.					
10	0 = ½ of £1	107646	0	0	price at	£7
5	0 = ½ of 10s.	7689	0	0	,,	10s.
4	0 = ⅕ of £1	3844	10	0	,,	5s.
0	8 = 1/6 of 4s.	3075	12	0	,,	4s.
0	0½ = 1/16 of 8d.	512	12	0	,,	8d.
		16	0	4½	,,	½d.
		122783	14	4½	,,	£7 19s. 8½d.

3. £22½ buy 3 cwt. 24 lbs. or 360 lbs.
1 buys 16 ,, *i.e.*, ⅐ cwt.
∴ £75 buy 10 cwt. 2 qrs. 24 lbs.

4. 42 ac. 1 ro. : 39 ac. 2 ro. 20 po. :: £158 8s. 9d. : x
or 6760 po. : 6340 po. :: 38025d.

$$\frac{38025\text{d} \times 6340}{6760} = £\frac{225 \times 317}{2 \times 240} = £148\ 11\text{s.}\ 10\tfrac{1}{2}\text{d.}$$

5. 1 rabbit = 8½d., and 1 hare = 3s. 6½d.
∴ 8½d. : 3s. 6½d. :: 162 hares : x rabbits.
or 17 halfp. : 85 halfp :: 162 hares : x rabbits.
162 hares × 85/17 = 810 rabbits, or 40½ score.

FEMALES.

1.

			£	s.	d.
21 lbs.	at 7½d. per lb.	=	0	13	1½
45 ,,	,, 4½d. ,,	=	0	16	10½
25½ ,,	,, 6½d. ,,	=	0	13	9¾
2¼ ,,	,, 2d. per oz.	=	0	6	0
10 lbs. 14 oz.	,, 4d. per lb.	=	0	3	7½
			2	13	5¼

2.

	£	s.	d.		
	7845	0	0		
			26		
	203970	0	0	price at	£26
10s. = ½ of £1	3922	10	0	,,	10s.
4s. = ⅕ of £1	1569	0	0	,,	4s.
8d. = 1/6 of 4s.	261	10	0	,,	8d.
½d. = 1/16 of 8d.	16	6	10½	,,	½d.
¼d. = ½ of ½d.	8	3	5¼	,,	¼d.
	209747	10	3¾	price of 7845.	

3.

	£	s.	d.			
	7985	0	0			
			8			
	63880	0	0	price of 7985 at £8		
10s. = ½ of £1	3992	10	0	,,	,,	10s.
5s. = ½ of 10s.	1996	5	0	,,	,,	5s.
4s. = ⅕ of £1	1597	0	0	,,	,,	4s.
4d. = 1/12 of 4s.	133	1	8	,,	,,	4d.
½d. = ⅛ of 4d.	16	12	8½	,,	,,	½d.
6/7 of £8 19s. 4½d.	7	13	9	,,	6/7 at £8 19s. 4½d. each.	
	71623	3	1½	,,	7985 6/7	

4.

	£	s.	d.		
	7	11	4		
			90		
	681	0	0	price of 90 qrs.	
1 pk. = 1/32 of 1 qr.		4	8¾	,,	1 pk.
	681	4	8¾	,,	90 qrs. 1 pk.

Grammar.

1. *sank*—intrans. verb, strong conj., *sink, sank, sunk*, indic., past, 3rd pers. sing., agr. with subj. *band.*
disappearing—verbal adj., qual. *band.*
each—distributive adj., qual. *warrior.*
vanished—intrans. verb, weak conj., indic., past., 3rd pers. sing., agr. with subj. *warrior.*
stood—intrans. verb, strong conj., *stand, stood, stood*, indic., past, 3rd pers. sing., agr. with subj. *he.*
seemed—intrans. verb, weak conj., indic , past, 3rd pers. sing., agr. with subj. *it.*
their—pronom. poss. adj., qual. *earth.*
mother—noun, used like an adj., qual. *earth.*
had swallowed—trans. verb, weak conj., indic., pluperfect, 3rd pers. sing., agr. with subj. *earth.*
or
had—past tense of the verb *have, had, had*, forming with the complete part.,
swallowed—a compound tense.
her—pronom. poss. adj., qual. *birth.*
warlike—adj., qual. *birth.*

2. The possessive case of nouns, both in the singular and plural, is formed by adding *'s* to the nominative, as—The *bird's* wing; The *men's* wages. When the plural nominative ends in *s*, the *s* that should follow the apostrophe—as the (') is called—is omitted, as—The *merchants'* union, instead of *Merchants's union.* When the singular ends in *es*, forming a distinct syllable, or in *ce* when the next word begins with *s*, the *s* is also omitted, as—*Socrates'* philosophy; For *conscience'* sake.

3. The past tenses of the given verbs are: *did, dared*, or *durst* (ventured), *could, should.*

Geography.

1. The *Severn* rises—that is, has its *source*—in the east side of the huge hill or *mountain* Plynlimmon. It flows almost due north through the vale of Montgomery, and enters the *plain*, or level ground of Salop, where it is joined by a small *affluent* or branch called the Tern. It now turns south, flowing through the *valley* or hollow, bounded on one side by the Wrekin and the Clent Hills, forming the *watershed* or separating range between the basins of the Severn and the Trent, and on the other by the. Clee and Malvern Hills. It is now increased by the *Stour* and *Terne.* Soon after entering Gloucestershire, it receives the *Avon*, which joins it at Tewkesbury, and this town is therefore said to stand near the *confluence* or meeting of the *affluent* with the main stream. The course of the river is now very winding as far as the ancient *city of Gloucester*, a cathedral town, where it meets the *tide*—that is, the periodic rise and fall, or flowing and ebbing of the waters of the ocean. It finally opens out to a broad *estuary* or river-mouth, forming the arm of the sea called the Bristol Channel.

2. Leaving *Belfast*, the second city in Ireland, chief seat of the linen manufacture, and having a good cross-channel trade, we pass *Carrickfergus*, a bathing-place, and turning south, we enter the large and well-sheltered anchorage of *Strangford Lough.* On its shore stands *Downpatrick*, the ancient capital of the Ulster kings. We reach *Dundalk*, noted for agricultural exports, and *Drogheda*, near which was fought the battle of the Boyne. Passing *Swords* we round *Howth Head*, and on Dublin Bay stands *Kingston*, the port of Dublin. Leaving Dublin, and beyond *Wicklow* we come to *Arklow*, the ancient capital of the kings of Leinster. Continuing south, we pass *Wexford*, and leaving the *Tuscar* light, we round *Carnsore* Point and enter Waterford harbour with the city of *Waterford*, which exports large quantities of agricultural produce. *Tramore* Bay, to the west, is one of the most dangerous places on the Irish Coast. Turning south, we come to *Youghal* harbour, and continuing our course we come to Cork, with a spacious harbour capable of holding the entire navy of England. In the centre of this basin is Goat Island, on which stands *Cove* or Queenstown, called after Her Majesty Queen Victoria.

Inverness—at the north end of the Caledonian Canal; chief town of the Highlands; near it Culloden Moor.

Skye—a large island of the Inner Hebrides, belonging to Inverness, separated from the mainland by the Sound of Sleat; the chief hills are the Coolin Hills, and the principal town is *Portree.*

Stafford is a small but neat town in Staffordshire, in England, and has trade in boots and shoes.

The Solway Frith—between Cumberland and Scotland; is remarkable for the rapid flow of its tide.

Scarborough is a famous watering-place on the coast of Yorkshire.

Yarmouth—on the coast of Norfolk; noted for its herrings, or 'bloaters.'

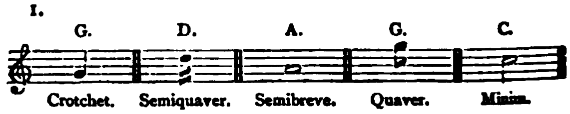
St. Albans—in Hertfordshire, where two battles during the 'Wars of the Roses' were fought.

Maidstone—in Kent, is in the centre of the 'hop country.'

Music.

1.

G. D. A. G. C.



Crotchet. Semiquaver. Semibreve. Quaver. Minim.

2.

3. Five tones and two semitones, the latter being found between the 3rd and 4th, and 7th and 8th notes.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Compare the values of £·775, and 7·75 shillings, and reduce their difference to the decimal of their sum.
2. What vulgar fraction of a guinea is £$\frac{9}{32}$, and what vulgar fraction of a mile is 82 yards 1 foot 6 inches?
3. What sum must be added to $\frac{7}{16}$ of 1⅓ guineas to make that fraction equal to $\frac{9}{10}$ of £3¾?
4. If a bar of gold weighing 5·05 lbs. be worth £243, what is the value of 3 oz. of the metal? Give answer in decimals and in £ s. d.
5. What is the total amount of a rate of £·3822916 in the £ on a property valued at £9.518 a year?

FEMALES.

1. If a bankrupt owed £7,241 5s., and paid 13s. 6d. in the pound, what was the total loss to the creditors?
2. How many horses can be bought for £744 8s. 8d. if seventeen horses cost £790 19s. 2½d.?
3. If 21 men earn £52 10s. in eight days of 10 hours each, how much will 49 men earn in 10 days of 5 hours each?
4. If 12 men eat bread to the value of £11 12s. 3d. in 28 days, when wheat is 52 shillings per quarter, how many men will eat bread to the value of £17 8s. 4½d. in 21 days, when wheat is 39s. per quarter?

Grammar.

1. 'The old Sussex tortoise that I have mentioned to you so often is become my property; I dug it out of its winter dormitory in March last, when it was enough awakened to express its resentments by hissing; and, packing it in a box with earth, carried it eighty miles in post-chaises.'—WHITE'S NATURAL HISTORY OF SELBORNE.

Point out and parse all the pronouns, prepositions, and participles in the above.

2. Is it ever allowable to place the preposition after, instead of before the word it governs? Illustrate your answer by examples.
3. The possessive cases of some pronouns are used as adjectives. Give examples of this.

Geography.

Answer *either* Q. 1 *or* Q. 3, *not both*.

1. Describe, as fully as you can, the basin of the Po, showing how it supplies you with examples of the use of the following terms, viz.:—*Affluent*, *City*, *Confluence*, *Delta*, *Gulf*, *Lake*, *Mountain*, *Plain*, *Source*, *Watershed*.

N.B.—These terms are here arranged alphabetically. You are to mention each *in its proper order*.

2. Draw a full map of Sicily, and another of Corsica and Sardinia. Insert the lines of latitude and longitude.
3. Say what you know about *Astrakhan*, *Archangel*, the *Arctic Circle*, *North Cape*, *Nova Zembla*, the *Gulf of Finland*, *Gothland*, *Memel*, and *Kiel*.

History.

1. Write out a list of names and dates of our sovereigns from 1066 to 1154.
2. What sovereigns reigned between Edward IV. and Elizabeth? Give their dates.
3. Give the name and hereditary title of the first king of the House of Hanover, with the date of his accession to the English throne. What relation is our Queen to him?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible*.

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act*, 1875.

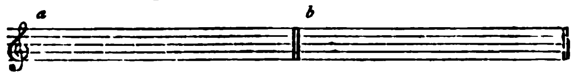
Composition.

Write from memory the substance of the passage read to you by the Inspector.

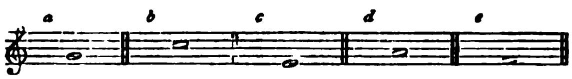
Music.

A quarter of an hour allowed for this paper.

1. Write in *a* the scale of D (*Re*), and in *b* the scale of B flat (*Se*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.



2. Place its second over *a*, its third over *b*, its fourth over *c*, its fifth over *d*, and its octave over *e*.



3. How many semiquavers are equal (in length) to one minim?

How many quavers are equal (in length) to one dotted minim?

How many crotchets are equal (in length) to one semibreve?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. £·775 = 15·5s. = two times 7·75s.

∴ 7·75 = their difference, and 15·5s. + 7·75 = 23·25 = their sum.

7·75 to the dec. of 23·25 = $\frac{7·75}{23·25}$ = ⅓ = ·$\dot{3}$. Ans.

2. (*a*) £$\frac{9}{32}$ to the fraction of a gui. = $\frac{9 \times 20}{32 \times 21} = \frac{3 \times 5}{8 \times 7} = \frac{15}{56}$. Ans.

(*b*) 1 ml. = 5280 ft. and 82 yds. 1 ft. 6 in. = 247½ ft.

∴ 247½ ft. to the fraction of 5280 ft. =

$\frac{247\frac{1}{2}}{5280} = \frac{495}{10560} = \frac{99}{2112} = \frac{3}{64}$. Ans.

3. $\frac{9}{10}$ of £3¾ − $\frac{7}{16}$ of 1⅓ gui. = £$\frac{9 \times 15}{10 \times 4}$ − £$\frac{7 \times 4 \times 21}{16 \times 3 \times 20}$ = £$\frac{27}{8}$ − £$\frac{49}{80}$ = £$\frac{270-49}{80}$ = £$\frac{221}{80}$ = £2 15s. 3d.

4. 5·05 lbs. : 3 oz. :: £243 : x.

£243 × $\frac{3}{60·6}$ = £$\frac{2430}{202}$ = £12·029$\dot{7}$, or £12 0s. 7$\frac{13}{101}$d. Ans.

5.

£·3822916
9518
30583328
3822916
19114580
34406244
£3638·6514488
20
13·028976s.

∴ the rate = £3638 13s. 0·347612d.

FEMALES.

1. The loss per £ is 6s. 6d.

	£	s.	d.	
	7241	5	0	
5s. = ¼ of £ ...	1810	6	3	loss of 5s. on every £.
1s. 3d. = ¼ of 5s.	452	11	6¾	„ 1s. 3d. „
3d. = ⅕ of 1s. 3d.	90	10	3¾	„ 3d. „
£	2353	8	1½	total loss.

2. £790 19s. 2½d. : £744 8s. 8d. :: 17 horses : x horses,

or

379661 halfp. : 357328 halfp.

17 horses × $\frac{357328}{379661} = \frac{357328}{22333}$ = 16 horses.

3. 21 men : 49 men ⎫
8 days : 10 days ⎬ :: £$52\frac{1}{2}$: x.
10 hours : 5 hours ⎭

$£\frac{105}{2} \times \frac{49}{21} \times \frac{10}{8} \times \frac{5}{10} = £\frac{1225}{16} =$

£76 11s. 3d. Ans.

4. £11 12s. 3d. : £17 8s. $4\frac{1}{2}$d.,

or

5574 halfp. : 8361 halfp. ⎫
21 days : 28 days ⎬ :: 12 men : x men.
39s. : 52s. ⎭

12 men $\times \frac{8361}{5574} \times \frac{28}{21} \times \frac{52}{39} =$ 32 men.

Grammar.

1. *that*—simple rel. com. gen., referring to *tortoise*. 3rd pers., obj. gov. by *mentioned*.
I—1st pers. pron. masc. sing. nom., subj. of *have mentioned*.
mentioned—complete part. of the trans. verb *mention*, forming with *have* the pres. perf. indic.
to—prep., gov. obj. case *you*.
you—2nd pers. pron. masc. (?) plural form sing. meaning, obj. gov. by *to*.
become—complete part. of the intrans. verb *come*, *came*, *come*, forming with *is* a tense = *has come*.
my—pronom. poss. adj., qual. *property* (or poss. case sing. of *I*).
I—1st pers. pron. (*as before*), subj. of *dug*.
it—3rd pers. pron. neut., referring to *tortoise*, sing. obj. gov. by *dug*. (The 3rd pers. pron. neut. is used with irrational animals.)
of—prep., gov. obj. case *dormitory*.
its—pron. poss. adj. (or poss. case of *it*), qual. *dormitory*.
in—prep., gov. obj. case *March*.
it—(*same as before*) subj. of *was*.
awakened—complete part. of the trans. verb *awake*, *awoke*, *awakened*, referring to *it*, and forming with *was* the past indef. tense, passive voice.
its—(*same as before*) qual. *resentment*.
by—prep., gov. the verbal noun or gerund *hissing*.
packing—incomplete part. of the verb *pack*, referring to *I*.
it—(*same as before*) obj. gov. by *packing*.
in—prep., gov. obj. case *box*.
with—prep. gov. obj. case *earth*.
it—(*same as before*) obj. gov. by *carried*.
in—prep., gov. obj. case *post-chaises*.

2. In *interrogative* and *relative* sentences the preposition is very often placed *after* the word which it governs. *What* did that give rise *to?* He is a man *whom* I have some acquaintance *with*. The preposition never stands before the relative *that*, as—The man *that* I gave the letter *to*; never The man *to* that, etc.

3. The following words are examples of the possessive cases of pronouns being used as adjectives, namely—*my*, *thy*, *our*, *your*, *his*, *her*, *its*, *their*; as, *My* book.

Geography.

1. The Po has its *source* at Mount Viso, a *mountain* in the Alps, forming the *watershed* which separates the basin of the Po from that of the Rhone. Flowing east through the *plain* of Lombardy, it is joined by these *affluents*—the *Sesia*, *Tanaro*, *Ticino* (which flows through *Lake* Maggiore). For a great portion of its course it forms the boundary between Lombardy and Piedmont. Continuing eastwards, the Po is joined by the *Trebbia*, the *Adda*, and then falls by several mouths (which form a *delta*) into the *Gulf* of Venice.

During this portion of its course it is joined by the *Oglio* and *Mincio* from the north, and the *Secchia* and *Panaro* from the south. Its total length is about 300 miles. The basin of the Po is limited by the Northern Appenines, and the Maritime, Cottian, Graian, Pennine, Lepontine, and Rhætian Alps.

The chief towns on its basin are, *Turin*, *Aosta*, *Casale*, *Asti*, *Alessandria*, *Pavia*, *Milan* (a *city* with a beautiful cathedral of white marble), *Piacenza* near the *confluence* of the Trebbia with the Po, *Como*, *Cremona*, *Parma*, *Mantua*, birthplace of Virgil, *Modena*, and *Ferrara*.

3. *Astrakhan*, a seaport of Russia on the Caspian Sea, and at the mouth of the Volga. It has great trade along the shores of the Caspian.

Archangel is a port of Russia on the White Sea. It is closed by ice a great part of the year. It exports corn, hemp, flax, and timber.

The *Arctic Circle* is a circle concentric with the Equator, drawn on the artificial terrestrial globe, about $23\frac{1}{2}°$ from the N. Pole. It encloses the North Frigid Zone.

North Cape on the Isle of Mageroe, 1,200 feet high, is the North of Lapland. Near it is Hammerfest, the most northerly town in Europe.

Nova Zembla, an archipelago in the Arctic Ocean, consisting of three large and several smaller islands.

The eastern arm of the Baltic is the *Gulf of Finland*, in which is the strong naval arsenal of *Cronstadt*, sixteen miles from St. Petersburg.

Gothland is the most fertile division of Sweden, and also an island in the Baltic.

Memel is a town on the Curische Haff, in Prussia. It has great exports of timber and corn.

Kiel is situated on the canal which joins the Baltic with the German Ocean.

History.

			A.D.
1.	Harold II.,	began to reign	1066
	William I.	" "	1066
	William II.	" "	1087
	Henry I.	" "	1100
	Stephen	" "	1135
	Henry II.	" "	1154–89

2. The sovereigns who reigned between Edward IV. and Elizabeth were:—

		A.D.
Edward V.,	began to reign	1483
Richard III.	" "	1483
Henry VII.	" "	1485
Henry VIII.	" "	1509
Edward VI.	" "	1547
Mary I.	" "	1553

3. The first king of the House of Hanover was George, whose hereditary title was Elector of Hanover. The relationship between our Queen and George I. is best shown thus:—

George I.
|
Son—George II.
|
Son—Frederick, Prince of Wales
|
Son—George III.
|
Son—Edward, Duke of Kent
|
Daughter—Victoria

She is therefore the great-great-great-granddaughter of George I.

Music.

1.

2.

3. Eight.
Six.
Four.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What percentage of a ton is (*a*) 1 cwt., (*b*) 1 quarter, (*c*) 1 lb., (*d*) 1 oz.? (Not more than four places of decimals.)

2. If £$43.542\frac{6}{7}$ produce at simple interest in $3\frac{1}{2}$ years £6667 10s., what is the rate per cent. per annum?

3. In a school of 250 children all examined, 70 fail in arithmetic, 50 in writing, and 20 in reading; what is the percentage of *passes* in each subject?

4. A sum of 30s. is divided among four boys in the proportion of 35 per cent. to A, 30 per cent. to B, 23·3 per cent. to C, and 50 per cent. of what C receives to D. How much money does each boy receive?

5. In what time will 29 half-sovereigns amount to 29 half-guineas at $2\frac{3}{4}$ per cent. per annum simple interest?

FEMALES.

1. A regiment returning from foreign service has only $\frac{11}{27}$ of its original number of men; it has lost $\frac{2}{9}$ of its original number in battle, $\frac{1}{3}$ by sickness, and 36 have deserted. What was its original number?

2. What is the amount of a bill for $\frac{3}{4}$ cwt. of sugar at $4\frac{1}{2}$d. a lb., $1\frac{1}{2}$ cwt. of rice at $4\frac{3}{4}$d. a lb., 70 lbs. currants at £2 6s. 8d. a cwt., and 25 lbs. of tea, $1\frac{1}{2}$ cwts. of it costing £28 10s. 6d.?

3. Simplify $3\frac{5}{8}$ of $\frac{5}{7}$ of $\frac{32}{301}$ of 49 of $1\frac{14}{29}$.

4. If it take $1\frac{1}{4}$ oz. of shot for a charge of a gun, how many shots can a boy have for 1 shilling's worth of shot at $2\frac{1}{4}$d. a lb.? How much shot will be left in his pouch after the last shot?

Grammar.

1. 'It is the first mild day of March,
Each minute sweeter than before;
The redbreast sings from the tall larch
That stands beside our door.
My sister! ('tis a wish of mine)
Now that our morning meal is done,
Make haste, your morning tasks *resign*,
Come forth, and feel the sun.'—WORDSWORTH.

(*a*) How many sentences are there in the above? Assign each to the class to which it belongs.
(*b*) Parse the words in italics.

2. What are corresponding conjunctions? Give a list of them.

Geography.

1. Say what you know about *Astrakhan, Archangel, North Cape, The Arctic Circle, Nova Zembla, The Bay of Bengal, Point de Galle, Auckland, Dunedin, Stewart Island.*

2. Draw a map of the Gulf of St. Lawrence, with Nova Scotia, New Brunswick, and Newfoundland.

One hour allowed for Females.
Two hours and a half allowed for Males.

History.

1. When and how did William I. die? Who inherited his dominions?

2. What celebrated Archbishop was assassinated in 1170? Describe the causes of that event.

3. Who ascended the throne in 1216? How came a French army to be in England at that time? How was it disposed of?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible.*

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act*, 1875.

Composition.

Write full notes of a lesson on *Lead.*

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation* are not admissible.]

1. Upon the same base, and on the same side of it, there cannot be two triangles that have their sides which are terminated in one extremity of the base, equal to one another, and likewise those which are terminated in the other extremity.

2. The angles which one straight line makes with another upon one side of it are either two right angles, or are together equal to two right angles.

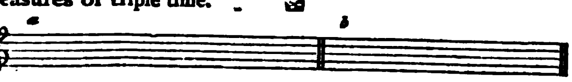
The lines bisecting an internal, and the adjacent external angle of a triangle, are at right angles to each other.

Music.

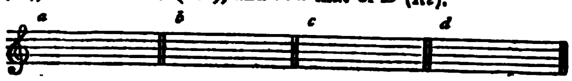
A quarter of an hour allowed for this paper.

1. Write under each of the following the name and quality (major, perfect, or other) of the interval it forms.

2. Write in *a* two meas res of mm n time; and in *b* two measures of triple time.



3. Write in *a* the signature of F (*Fa*), in *b* that of B flat (*Se*), in *c* that of G (*Sol*), and in *d* that of D (*Re*).



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. 1 cwt. is $\frac{1}{20}$ of a ton $\frac{100}{20}$ of 100 tons, *i.e.*, 5 p.c.
1 qr. „ $\frac{1}{80}$ „ $\frac{100}{80}$ „ „ 1·25
1 lb. „ $\frac{1}{2240}$ „ $\frac{100}{2240}$ „ „ ·0446...
1 oz. „ $\frac{1}{35840}$ „ $\frac{100}{35840}$ „ „ ·0027...

2. $\left.\begin{array}{l}£43542\frac{6}{7} : £100 \\ 3\frac{1}{2} : 1\end{array}\right\} :: £6667\frac{1}{2} : x.$

$£\frac{13335}{2} \times \frac{700}{304800} \times \frac{2}{7} = £4\frac{3}{8}$ p. c.

3. (250–70) or 180 pass in arithmetic.
(250–50) or 200 „ writing.
(250–20) or 230 „ reading.
$\frac{180}{250}$ of 100 = $\frac{18000}{250}$, or 72 p. c. in arithmetic.
$\frac{200}{250}$ of 100 = $\frac{20000}{250}$, or 80 „ writing.
$\frac{230}{250}$ of 100 = $\frac{23000}{250}$, or 92 „ reading.

4. s. d.
$\frac{35}{100}$ of 30s. $= \frac{30s. \times 35}{100} =$ 10 6 A's share
$\frac{30}{100}$ of 30s. $= \frac{30s. \times 30}{100} =$ 9 0 B's „
$\frac{23\frac{1}{3}}{100}$ of 30s. $= \frac{30s. \times 70}{300} =$ 7 0 C's „
$\frac{50}{100}$ of $\frac{23\frac{1}{3}}{100}$ of 30s. $= \frac{30s. \times 50 \times 70}{100 \times 300} =$ 3 6 D's „

5. Interest on 29 half sovs. = 29 half guis. — 29 half sovs. = 14s. 6d.

$\left.\begin{array}{l}\text{29 half sovs.} : \text{200 half sovs.} \\ 55s. \quad\quad : 14\frac{1}{2}s.\end{array}\right\} :: 1 \text{ yr.} : x.$

1 yr. $\times \frac{200}{29} \times \frac{29}{110} = 1\frac{9}{11}$ yr. Ans.

FEMALES.

1. If $\frac{11}{27}$ return then $\frac{16}{27}$ must have been lost.
$\therefore \frac{16}{27} - (\frac{2}{9} + \frac{1}{3})$ must give 36.
or $\frac{16-15}{27} = \frac{1}{27} = 36.$

If 36 is $\frac{1}{27}$ of the whole, then the whole must be 36 × 27 or 972 men. Ans.

2.

	£	s.	d.
$\frac{3}{4}$ cwt. at $4\frac{1}{2}$d. per lb.	= 1	11	6
$1\frac{1}{2}$ cwt. at $4\frac{3}{4}$d. „	= 3	6	6
70 lbs. at £2 6s. 8d. per cwt.	= 1	9	2
25 lbs. at £28 10s. 6d. for $1\frac{1}{2}$ cwt.	= 4	4	$10\frac{2}{3}$
	10	12	$0\frac{2}{3}$

3. $\frac{29}{8}$ of $\frac{5}{7}$ of $\frac{32}{301}$ of $\frac{49}{1}$ of $\frac{43}{29}$ =
$\frac{29 \times 5 \times 32 \times 49 \times 43}{8 \times 7 \times 301 \times 1 \times 29} = 20.$ Ans.

4. (*a*) 9 farths. purchase 16 oz.
1 „ „ $\frac{16}{9}$ oz.
∴ 1s. or 48 „ „ $\frac{16 \times 48}{9}$ oz.
i.e. $\frac{256}{3}$ oz.

$\frac{256}{3}$oz. $\div 1\frac{1}{4} = \frac{256 \times 4}{3 \times 5} = \frac{1024}{15} = 68\frac{4}{15}$ charges.

(*b*) $\frac{4}{15}$ of $1\frac{1}{4}$ oz. $= \frac{4 \times 5}{15 \times 4}$ oz. $= \frac{1}{3}$ oz. left in pouch.

Grammar.

1. (1) '*It is the first mild day of March, each minute sweeter than before.*' Principal sentence.
(2) '*The redbreast sings from the tall larch.*' Principal sentence.
(3) '*That stands beside our door.*' Adjective sentence.
(4) '*My sister! make haste.*' Principal sentence.
(5) '*Now that our morning meal is done.*' Adverbial sentence.
(6) '*Your morning tasks resign.*' Principal sentence.
(7) '*Come forth.*' Principal sentence.
(8) '*And f el the sun.*' Principal sentence.
(9) ('*'Tis a wish of mine.*') Parenthetical sentence.

(*b*) *each*—distrib. adj. qual. *minute.*
minute—abstr. noun, neut. sing. nom. absol. (*being.*)
sweeter—adj. compar. degree, qual. *minute.*
than—conj. connecting '*each minute* (*being*) *sweeter*,' with '(*the one which was sweet*) *before* (*it.*)'
before—prep. gov. obj. case (*it.*)
my—pronom. poss. adj. qual. *sister.*
sister—noun, fem., sing. vocative case or nom. of address.
resign—trans. verb, weak conj., imperative mood, pres. 2nd pers. sing. agreeing with subj. (*thou.*)
come—intrans. verb, strong conj., *come, came, come*, imper. mood, pres. 2nd pers. sing. agr. with subj. (*thou.*)
forth—adv. of place modif. *come.*

2. Corresponding conjunctions are those which go in pairs, or are co-relative with one another, thus :—*Either* requires *or* after it ; *neither, nor ; whether, or ; both, and ; though, yet.*

Geography.

1. *Astrakhan* is a seaport of Russia on the Caspian Sea and at the mouth of the Volga. It has great trade along the shores of the Caspian.

Archangel is a port of Russia on the White Sea. It is closed by ice a great part of the year. It exports corn, hemp, flax and timber.

North Cape, on the Isle of Mageroe, 1200 feet high, is in the north of Lapland. Near it is Hammerfest, the most northerly town in Europe.

The *Arctic Circle* is a circle concentric with the Equator, drawn on the artificial terrestrial globe, about 23½° from the North Pole. It encloses the North Frigid Zone.

Nova Zembla an archipelago in the Arctic Ocean, consisting of three large and several smaller islands.

The Bay of Bengal is a large arm of the Indian Ocean separating Hindostan from Further India. Its north shore is about 250 miles broad ; its side next the ocean about 1200 miles. This bay receives the Ganges and Sanpoo on the north, the Irrawady on the east, and the Mahanuddy, Godavery and Krishna on the west.

Point de Galle is a town on the S.W. coast of Ceylon. It is a station for steamboats, and has a healthy climate.

Auckland is the capital of New Zealand, and a place of considerable commerce, favoured with a salubrious climate.

Dunedin on Otago Harbour is the capital of the province of Otago in New Zealand.

Stewart Island is the smallest of the three islands which form the New Zealand group. It is quite unimportant, being uninhabited.

History.

1. William I. was laying waste the borders between his Norman dominions and those of the King of France on account of a rude jest made upon him by the latter. While riding through the burning town of Mantes his horse stumbled, and William, being pitched forward, received injuries which led to his death some weeks after.

His son William succeeded him in England and Robert in Normandy.

2. In 1170 Thomas a' Becket, the famous Archbishop of Canterbury, was assassinated by four knights of the Court of Henry II. His murder resulted from an unguarded expression let fall by the King, who had long had a grudge against the prelate ; first, for leading an austere life, then for his obstinacy in holding out against the Constitutions of Clarendon, and latterly for his so haughtily suspending the Archbishop of York from his office for usurping Becket's rights in the matter of the coronation of Henry's eldest son as Viceroy of England.

3. King Henry III. ascended the throne of England in 1216. His father (King John) having taken the field against his own subjects with a band of hireling soldiery, was pillaging and laying waste the country. The barons, in their extremity, applied to Philip Augustus of France, and offered the crown to his son Louis if he would come over and take it. Louis landed in Kent and received homage from a large number of the barons. However, the barons afterwards rallied round the young King, and, under the leadership of the Earl of Pembroke and Hubert de Burgh, they drove the French intruders from the country.

Composition.

Notes of a lesson on *Lead.*

Character.—Lead is a metal of a bluish-grey colour, somewhat brilliant when freshly cut, easily bent, very malleable, very fusible or easily melted, soft, marks paper and soils it slightly, somewhat after the manner of a plumbago pencil.

How obtained.—Got from mines in the form of ore called *galena*, combined with earthy matters, silver, and sulphur.

Manufacture.—The ore crushed, washed, smelted, melted metal run into moulds, forming pig lead ; silver now extracted from it, varying from 1 oz. to 30 oz. in a ton of lead.

Uses.—The most extensive use of lead is in the form of sheets, pipes or tubes for the passage of fluids, bullets ; making of lead shot very interesting—metal mixed with arsenic, melted in a furnace, poured through a perforated plate into a tub of water at the bottom of a lofty tower or a deep pit ; the globules are formed by the fall into shot, which is sorted and dried—roofs of houses covered with sheet-lead ; Chinese make fine sheets for lining tea boxes.

Where got.—Principally in Yorkshire, Cumberland, Flintshire, Durham, and Cornwall.

Euclid.

1. Prop. 7, Bk. I.
2. Prop. 13, Bk. I.

Rider.—Since the interior angle, along with its adjacent exterior, is equal to two right angles, then the bisecting lines must contain *one angle* equal to the half of *two right angles*, and therefore that contained angle must be a right angle. Q. E. D.

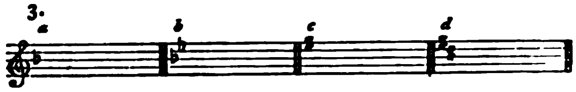
Music.

1.

Perfect 4th. Imperfect 5th. Minor 7th. Imperfect 5th. Major 6th.

2.

3.



THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May,* 1878 ; **and Pupil Teachers at end of Fourth Year, if apprenticed before that date.**

Three hours and a half allowed.

Arithmetic.

MALES.

1. What principal put out for 6½ years at 4½ per cent. simple interest will amount to £1,002 19s. 7½d. ?
2. At what price are the Funds when I can buy £500 worth of Stock for £401 13s. 4d. ?
3. If a tradesman gain 2s. 9d. on an article which he sells for 11s., what is his gain per cent. on his outlay in procuring the article?
4. What percentage is (*a*) ½d. of 3 half-crowns ? (*b*) 3 poles of 3 acres ? (*c*) 3½ days of a year (of 365 days) ?
5. A market woman in the morning sells her butter at 15 per cent. profit ; in the afternoon the price of butter rises 1d. per lb., and she then makes 20 per cent. profit. What did the butter cost her to buy ?

FEMALES.

1. Divide £870 between A, B, and C, so that ·75 of C's share shall = ·5 of A's, or = ·6 of B's.
2. Multiply 3·456 by ·425, and divide 2·472 by 3·4.
3. A schoolmaster divided his scholars, consisting of 221 boys and 143 girls, into the largest possible equal classes, so that each class of boys should number the same as each class of girls. Find the number of classes.
4. Express 9¾d. as the decimal (1) of £1, (2) of £1,000.

Grammar.

1. 'Picture galleries should be the working man's paradise, to which he goes to refresh his eyes and heart with beautiful shapes and sweet colouring, when they are wearied with dull bricks and mortar, and the ugly, colourless things which fill the town, the workshop, and the factory.'—KINGSLEY.

(*a*) Point out the extensions of the predicate that occur in the above.

(*b*) Analyse the adverbial sentence.

(*c*) What kind of subordinate sentences are connected with principal sentences by relative pronouns? Give examples from the above and from other passages.

2. Parse each word in the following:—

'Make me, that nothing have, with nothing grieved.'

3. With what Latin prepositions are the following words compounded:—*accept, irrigate, comfort?* (N.B.—There is no Latin preposition *ac, ir,* or *com.*)

Geography.

1. Draw a full map of Africa, to the east of the 30th meridian of east longitude—that is, to the east of Alexandria on the north, and Port Natal on the south.

2. Describe fully the great mountain chains of Asia, and name the principal rivers rising in each, with the direction of their courses.

One hour allowed for Females, two hours and a half allowed for Males.

History.

1. Who were the parents of Edward VI.? Two of his uncles were beheaded; give some account of them.

2. Describe the government of this country between 1649 and 1660.

3. What was the last battle at which an English king appeared on the field?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible.*

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act,* 1875.

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation* are not admissible.]

1. If a side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles, and the three interior angles of every triangle are together equal to two right angles.

In a right-angled triangle, the angle contained by the line bisecting the right angle, and the line drawn perpendicular to the hypotenuse, is equal to half the difference of the two acute angles of the triangle.

2. In any right-angled triangle, the square which is described upon the side subtending the right angle is equal to the squares described upon the sides which contain the right angle.

Algebra.

1. Divide $x^{15}+y^{10}$ by x^3+y^2, and $x^4-\frac{19}{6}x^2y^2+\frac{1}{3}xy^3+\frac{1}{6}y^4$ by $x^2+2xy+\frac{1}{2}y^2$.

2. Take $\frac{4x-3}{25(x^2+1)}$ from $\frac{4x+13}{25(x+2)^2}$

3. Solve the equations:—

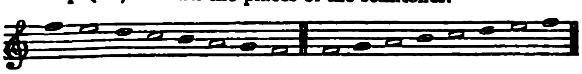
(1) $\frac{x}{a}+\frac{x}{b}=c$

(2) $\frac{1}{2}(x-\frac{11}{16})-\frac{2}{15}(1-3x)=x-\frac{1}{30}\left(5x-\frac{1-\cdot 3x}{\cdot 4}\right)$

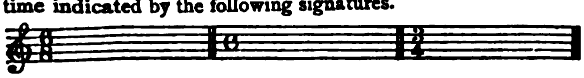
Music.

A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of F sharp (*Fe*). Mark the places of the semitones.



2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures.



3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature.

ANSWERS.—THIRD YEAR.

MALES.

1. Interest of £100 for $6\frac{1}{2}$ years at $4\frac{1}{2}$ p.c. = £29 5s.

Amount ,, ,, ,, = £129 5s.

∴ £129 5s. : £1002 19s. $7\frac{1}{2}$d. :: £100 : x,

or 31020d. : $240715\frac{1}{2}$d.

£100 × $\frac{1203577\frac{1}{2}}{155100}$ = £$\frac{401192\frac{1}{2}}{517}$ = £776. Ans.

2. The question is this:—If £500 cost £$401\frac{2}{3}$, what will £100 cost?

∴ £500 : 100 :: $401\frac{2}{3}$: x

£$\frac{1205}{3}\times\frac{100}{500}=\frac{241}{3}$ = £$80\frac{1}{3}$. Ans.

3. The outlay must have been 11s. − 2s. 9d., *i.e.*, 8s. 3d.

∴ 99d. gains 33d.

1d. ,, $\frac{33}{99}=\frac{1}{3}$

100 ,, $\frac{1}{3}\times 100$

i.e., $33\frac{1}{3}$ p.c. Ans.

4.

$\frac{3}{4}$d. = $\frac{1}{120}$ of 3 half-cro. ∴ the percentage is $\frac{100}{120}$, *i.e.*, $\frac{5}{6}$ or ·83.

3 po. = $\frac{1}{160}$ of 3 acres ∴ ,, ,, $\frac{100}{160}$, ,, $\frac{5}{8}$,, ·625.

$3\frac{3}{4}$ das. = $\frac{3}{292}$ of 365 days ∴ ,, ,, $\frac{300}{292}$, ,, $1\frac{2}{73}$

or 1·0273....

5. A rise of 1d. on the lb. gives a rise of 5 p.c.

or $\frac{1}{20}$ of the prime cost.

∴ the prime cost must have been 1d. × 20 = 1s. 8d.

FEMALES.

1. ·75 of C's = ·5 of A's = ·6 of B's.

∴ the proportions are 1 : 1·5 : 1·125 = the total 3·615.

or clearing of decimals 8 : 12 : 9 = ,, 29

∴ A gets $\frac{12}{29}$ of £870, or £360. Ans.

B ,, $\frac{9}{29}$,, £270. Ans.

C ,, $\frac{8}{29}$,, £240. Ans.

2. (*a*) ·42$\dot{5}$ = $\frac{383}{900}$ ∴ 3·456 × $\frac{383}{900}$ = ·00384 × 383

```
 ·00384
    383
 ------
   1152
  3072
 1152
 ------
 1·47072.  Ans.
```

(*b*) 3·4)2·472(·72. Ans.

```
  2 38
  ----
    92
    68
```

3. Find the G.C.M. of 221 and 143.

1	221	143	1
	143	78	
1	78	65	5
	65	65	

13 = G.C.M.

The greatest number of classes of *boys* with 13 in each class = $\frac{221}{13}$ or 17; and of *girls* with ,, ,, = $\frac{143}{13}$ or 11.

total 28 classes.

4. (*a*) $9\frac{3}{4}$ to the dec. of 960 farths. = $\frac{9\frac{3}{4}}{960}=\frac{39}{12\times 8}$ = ·040625.

(*b*) ∴ $9\frac{3}{4}$ to the dec. of £1000 = $\frac{\cdot 040625}{1000}$ = ·000040625.

Grammar.

(*a*) The extensions of the predicate are: (1) '*to which he goes to refresh his eyes......and the factory*' extends the word *paradise* in the predicate of the principal sentence. (2) '*to refresh his eyes, etc.......colouring*' extends the predicate '*goes.*' (3) '*when they are wearied......factory*' extends the predicate '*goes.*' (4) '*with dull bricks, etc.......factory*' extends the predicate '*are wearied.*' (5) *to which* extends '*goes.*'

(*b*) Analysis of adverbial sentence:—
' *When* '—connective.
'*they*'—subject.
'*are wearied*'—predicate.
'*with dull bricks, etc.......factory*'—extension of the predicate (*cause*).

(*c*) *Subordinate adjective* sentences are connected with principal sentences by relative pronouns, as:—(1) '*to which he goes,*' *etc.* (2) '*which fill the town, the workshop, the factory.*' (3) 'My spirit flew in feathers then *That is so heavy now.*' (4) 'Make me, *that nothing have,* with nothing grieved.' (5) 'Point out the extensions of the predicate *that occur in the above.*'

2. *Make*—trans. verb, irreg. *make, made, made,* imper., pres., 2nd pers. sing., agr. with subj. (*thou*).
me—1st. pers. pronoun, com., sing., obj. gov. by *make.*
that—simple rel., referring to *me,* 1st pers., etc., nom., subj. of *have.*
nothing—noun, neu., sing., obj. gov. by *have.*
have—trans. verb, irreg., *have, had, had,* indic., pres. indef., 1st pers. sing., agr. with *that* (=I).
with—prep., gov. obj. case *nothing* (or showing the relation between the notion of *grieving* and *nothing*).
nothing—(*same as before*) gov. by *with.*
(*to be*) *grieved*—complete part of the verb *grieve* referring to *me* (with *to be* it forms pres. indef. infinitive, passive, the *to be* being omitted after *make*).

3. *Accept* is compounded with *ad,* 'to'; *irrigate* with *in,* 'into'; and *comfort* with *cum,* 'with.'

Geography.

1. The greatest mountain system in Asia is the *Himalayan* system, which occupies a position not very far from the centre of the continent. It extends nearly 2,000 miles from north-west to south-east, and has a breadth varying from one to five and six hundred miles. Different names have been given to different portions of the system, such as *Hindu Kush* (the N.W. extremity), *Karakorum,* and *Kuen-lun,* while *Himalaya* is more especially confined to the northern barrier of Hindostan. The Kuen-Lun forms the northern flank of the mass, the broadest part of the system lying between this and the Himalaya proper. The highest peaks in the world are found in this system, namely, *Mount Everest,* 29,002 feet, and *Kunchinjunga,* 28,156 feet.

The rivers which rise in this system are:—The *Indus,* flowing W. and S.; the *Ganges,* flowing eastwards; and the *Brahmapootra,* flowing east and south to join the Ganges.

A second great mountain system of Central Asia, connected with the foregoing by the plateau of Pamir, is the *Thian-Shan* system, continued by the *Altai, Sayansk,* the *Yablonoi,* the *Stanavoi,* and *Aldan* ranges to the N.E. point of the continent at Behring Sts. From that almost unbroken chain spring the *Irtish* and *Obi,* the *Yenesei,* and the *Lena* flowing northwards; while the *Amoor* is the only river of importance flowing eastwards.

From the Kuen-Lun a chain extends north-east called in various parts *Nan Shan, In-Shan,* and *Kin-ghan,* giving rise to the *Yanktsekiang* and the *Hoangho* flowing eastwards.

From the *Armenian Mountains* in Turkey in Asia rise the *Euphrates* and *Tigris,* flowing south, and joining before they fall into the Persian Gulf.

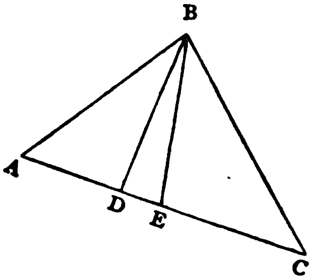
History.

1. The parents of Edward VI. were Henry VIII. and Jane Seymour. His two uncles were *Edward Seymour,* Duke of Somerset, and *Lord Seymour,* High Admiral of England. The latter having gained over to his side many nobles jealous of Somerset's power as Protector, planned a rising, which failed, and he was beheaded on Tower Hill. The Duke had endeavoured to follow up the policy of Henry VIII. regarding the marriage of Edward VI. and Mary, the young Queen of Scotland, but he was unsuccessful. A rebellion in Norfolk, caused by the oppression of the peasantry, made him still more unpopular, and his pride, usurpation of all power in the state, and his pulling down bishops' houses to build a mansion for himself, led the Earl of Warwick to head a party hostile to him. He was sent to the Tower, and eventually beheaded, 1552.

3. The last battle at which an English king appeared in the field was at *Dettingen,* where George II. led the English and Germans who fought in the cause of Maria Theresa, Queen of Hungary (1743).

Euclid.

1. Prop. 32, bk. 1.



Let ABC be the triangle, right angled at B. Let the angle at B be bisected by BE, and let BD be drawn perpendicular to AC, the hypotenuse; then the angle DBE shall be equal to half the difference between the angles BAC, ACB, *or twice the angle DBE is equal to their difference.* It can easily be seen by I. 32 that *the angle ABD* is equal to *the angle at C;* and *the angle DBC* equal to *the angle at A.* Now the angle ABE = angle EBC, and the angle ABE = angles ABD, DBE. ∴ EBC = ABD, DBE. To each of these equals add the angle DBE, ∴ the angles EBC, DBE = ABD, and twice DBE; that is, DBC or *angle at A* = ABD or *angle at C* and twice DBE; that is, *the angle at A* is greater than *the angle at C* by *twice DBE;* or in other words, DBE is equal to *half the difference* between the two angles.

2. Prop. 47, bk. 1.

Algebra.

1. (*a*) $x^3+y^2)\ x^{15}+y^{10}\ (\underline{x^{12}-x^9y^2+x^6y^4-x^3y^6+y^8}.$ Ans.

$$\begin{array}{r} x^{15}+x^{12}y^2 \\ \hline -x^{12}y^2 \\ -x^{12}y^2-x^9y^4 \\ \hline x^9y^4 \\ x^9y^4+x^6y^6 \\ \hline -x^6y^6 \\ -x^6y^6-x^3y^8 \\ \hline x^3y^8+y^{16} \\ x^3y^8+y^{10} \\ \hline \end{array}$$

(*b*) $x^2+2xy+\frac{1}{3}y^2)\ x^4-\frac{13}{6}x^2y^2+\frac{1}{3}xy^3+\frac{1}{4}y^4\ (\underline{x^2-2xy+\frac{1}{2}y^2}.$ Ans

$$\begin{array}{r} x^4+\ 2x^3y\ +\frac{1}{3}x^2y^2 \\ \hline -\ 2x^3y\ -\frac{5}{2}x^2y^2+\frac{1}{3}xy^3 \\ -\ 2x^3y\ -4x^2y^2-\frac{2}{3}xy^3 \\ \hline \frac{3}{2}x^2y^2+xy^3+\frac{1}{4}y^4 \\ \frac{3}{2}x^2y^2+xy^3+\frac{1}{4}y^4 \\ \hline \end{array}$$

2.
$$\frac{4x+13}{25\ (x+2)^2}-\frac{4x-3}{25(x^2+1)}=$$
$$\text{L. C. Denr.}=25\ (x+2)\ (x+2)\ (x^2+1)$$
$$\frac{(4x+13)\ (x^2+1)-(4x-3)\ (x^2+4x+4)}{25\ (x^2+4x+4)\ (x^2+1)}=$$
$$\frac{4x^3+13x^2+4x+13-(4x^3+13x^2+4x-12)}{25(x^4+4x^3+5x^2+4x+4)}=$$
$$\frac{1}{(x^4+4x^3+5x^2+4x+4)}$$

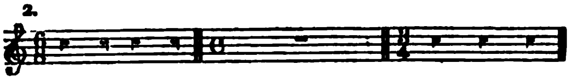
3. (1)
$$\frac{x}{a}+\frac{x}{b}=c$$
$$bx+ax=abc$$
$$x\ =\frac{abc}{a+b}$$

(2)
$$\frac{x}{2}-\frac{51}{52}-\frac{2}{13}+\frac{6x}{13}=x-\frac{5x}{39}+\frac{10-3x}{156}$$
$$\text{L. C. Denr.}=156-$$
$$78x-153-24+72x=156x-20x+10-3x$$
$$173x-156x=187$$
$$17x=187$$
$$x=\underline{11}.\ \text{Ans.}$$

Music.

1.

2.



3.

[Owing to the great pressure on our space, we are compelled to omit the Questions for the Fourth Year. They will, however, be inserted in our next i sue.]

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Monthly Notes.

THE BRITISH ASSOCIATION AT YORK.—Sir John Lubbock, M.P., President of the British Association for the Advancement of Science, delivered the inaugural address of the fiftieth meeting at York on the 31st August. A large and brilliant company, including Professors Owen, Huxley, Roscoe, Marsh, Whitney, Carey, Sir J. Hooker, Sir W. Thomson, Mr. Spottiswoode, the Dean of York, and others well known in the scientific world, was present. The President commenced by referring to the fact that the cathedral city was the cradle of the Association, its first meeting being held there in 1831, and went on to review the results which had been achieved within the half-century in the various departments of science. He said that fifty years ago the general opinion was that plants and animals came into existence just as we now see them. We took pleasure in their beauty; their adaptations to their habits and mode of life could not in many cases be overlooked or misunderstood. Nevertheless, the book of Nature was like some richly-illuminated missal written in an unknown tongue; we perceived the beauty, but of the true meaning little was known to us; indeed, we scarcely realised that there was any meaning to decipher. Now glimpses of the truth are reviving themselves; we perceive there is a reason—and in many cases we know what that reason is—for every difference of form, of size, and of colour. He referred to the antiquity of man, and reviewed the evidences of the race having passed through the stone, bronze, and iron age. The great glacial epoch must be fixed three hundred thousand years ago, and the fact is established that man inhabited these islands in the milder periods of that epoch. The right honourable baronet in concluding a long and extremely interesting speech, summed up the principles which have been established in the last half-century, and mentioned the innumerable applications of science to practical life. He could not but hope that fifty years hence his successor in the chair would have to record a series of discoveries even more unexpected and brilliant than those which he had referred to that evening, for one great lesson which science teaches us is, how little we yet know, and how much we have still to learn.

THE DUKE OF DEVONSHIRE ON EDUCATION.—The Duke of Devonshire in laying the foundation-stone of a new Grammar-school at Carlisle on the 6th inst., took occasion to refer to the present state of education. He said that public opinion in this country had pronounced itself very clearly upon the question of education, and undoubtedly the country had made up its mind most decidedly that it intends to be a well-educated country, and was rapidly taking steps towards the completion of the edifice of education. So far, indeed, as elementary education was concerned, the law had taken the matter into its own hands, and in all probability in a very short time there would scarcely be a person to be found in the country destitute of such elementary knowledge as is comprised in reading, writing, and arithmetic. As to the provision made for education of a higher and more advanced kind than that supplied by elementary schools, although the Legislature, for very good reasons, had not thought fit to insist upon the systematic establishment of such schools throughout the country, and although it would be going much too far to assert that the country was adequately supplied with such schools, yet he was happy to think that during the last few years many and important steps had been taken to meet the requirements in that direction. We now possessed a large number of schools of this kind, differing from one another in many important respects, but all in their several ways contributing to meet the additional demands of those who needed an education above that supplied by elementary schools.

EDUCATION IN WALES.—Mr. Lewis Morris, author of 'The Epic of Hades,' in presiding over the Welsh National Eistedfodd, made some remarks on the subject of Welsh Education. He said that as one of the members of the Royal Commission he felt he was expected to make some statement regarding the work in which they were engaged. In the course of their inquiry, which embraced the whole of the Principality, they discovered that there was only school accommodation, other than elementary, for 3,000, although, taking the low average of 10 for every 1,000 inhabitants, there ought to be, with the population which Wales possessed, accommodation for 15,700. That, however, was not the worst. Not only was the accommodation deficient, but even the meagre advantages offered were not utilised, for instead of 15,700, only 1,570 attended public schools higher than elementary. This was increased, no doubt, by the number who attended private and preparatory schools; but until these schools were brought under some sort of inspection, it would be unwise to count on them giving an efficient education. After making a short statement as to what the Commission intended to do, Mr. Morris concluded by saying that all they now needed was the co-operation of the Welsh people, and he believed they would get it.

NATIONAL UNION OF ELEMENTARY TEACHERS.—The first meeting since the recess of the Executive Committee of the N. U. E. T. was held at the office in Adam Street, Adelphi, W.C., on Sept. 3rd, at 11 a.m., the President, Mr. J. R. Langler, B.A., in the chair. After the minutes of the last meeting had been read and signed, the President said that it gave him pleasure to congratulate the members of the Executive on the resumption of their labours. The evident cheerful indications of renewed energy derived from a well-earned rest at home, or from the delights of travel, were pledges of a power of diligent, earnest attention to the very heavy work that seemed to lie before them. After touching upon one or two important points respecting the New Code, and referring to the Goffin case, Mr. Langler said that he had received an invitation from the Belgian Teachers' Union to attend their meetings at Antwerp, but had, however, declined the acceptance of it. He trusted that the Executive might have a prosperous session, for there was much work to be

done, and some of it in a short time. The Report, which gave particulars of the Parliamentary work done, and referred to the New Code, Organisation, etc., was then read. The Secretary said that in entering on a new session he would urge upon the Executive the importance of completing as quickly as possible their consideration of the Government proposals of the Code. A communication on the subject would at once be made to the local associations, and their final decisions on the proposals should be in hand by the middle of October, in order that the Executive may again approach the Department with any further criticisms or suggestions which might be deemed necessary. After some business of minor importance, and the appointment of the President and Secretary as a deputation to attend the Social Science Congress in Dublin, from October 3rd to 10th, the Executive rose. A vote of thanks was given to the Chairman.

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Gossip.

The National Society has done good service in issuing their 'Form of Agreement,' which we print in another column. As it can be easily adapted to particular cases, we advise both managers and teachers, where no agreement already exists, to draw one up. A legal contract is far more satisfactory than trusting to each other's 'honour.' The engagement of a teacher is a matter of business, and, as such, should be done in a business manner. We mention the above because a painful case of misunderstanding—the result of a *verbal* arrangement—has just been brought under our notice. We hope all whom it may concern will take the hint.

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Once a year there is issued for the benefit of 'the people called Methodists' an interesting volume entitled, 'Minutes of Conference.' All loyal members of that ilk read this book, as it contains a digest of the year's work. Teachers, and others interested in educational matters, who have already perused their copies, will, we venture to say, have been both surprised and annoyed at some of the remarks which appear under the heading, '*Transactions of the Education Committee*.' Part of the paragraph is so manifestly unfair to the staff at the Westminster College that we cannot let it pass unchallenged. Allusion having been made to the late Mr. Sugden's valuable services, we are informed that—

'Subsequently the Committee considered what measures, in connection with the staff of the Westminster College, would become necessary in consequence of Mr. Sugden's death. They decided as follows:—That Mr. Cha les Mansford, B.A., should be designated Vice-Principal of the College; that no one of the Tutors should be designated Head Master; but that a Tutor should be appointed upon the staff who had had the advantage of an Oxford or Cambridge University training, and who would be able *to advance the classical and mathematical instruction given in the College*. In accordance with this decision, the Committee have appointed Mr. James Sugden, B.A. (Cantab), son of the late Mr. William Sugden, to be a Tutor of the College after Christmas next.'

We print the above extract, not so much to draw attention to the bad grace with which Mr. Mansford's well-merited appointment is recorded, as to the part we have taken the liberty to put in italics.

We enter our emphatic protest against this nonsense, and regret that those responsible for the paragraph should have gone so far out of their way to insult the present able staff. It is ridiculous to talk of 'advancing the classical and mathematical instruction in the College' by importing a youth raw from his University, while such men as Mansford, Kinton, Reatchlous, and Langler—men of the ripest scholarship and experience—are retained. These men had earned their laurels long before Mr. James Sugden was in his swaddling clothes. It would have been far better to have told the simple truth. The facts of the case are these:—The late Mr. Sugden rendered excellent service as the Head Master of the College. Respect for his memory, and a desire to mark their appreciation of his life-work, prompted the committee to do a generous act—they invited the son to fill a subordinate place on the staff. But to allege that the appointment of this young man, who has not distinguished himself either in classics or mathematics, will improve the quality of the instruction given at Westminster, is not only 'playing it low down' (as our American friends would say) on the present devoted staff, but reveals a state of ignorance on the part of some one—if they are sincere — that we certainly never looked for. Against Mr. Sugden we have not a word to say: we wish him a long and prosperous career at Westminster. He knows, as every one does, that when he enters upon his new duties he will have to be taught how to do his work by the very men who years ago, to our knowledge, taught him classics and mathematics.

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We are glad to see that the Crystal Palace Company have again made arrangements for their winter classes. These are a great boon to the young ladies—gentlemen are only admitted to the school of engineering and the school of gardening—resident in the neighbourhood. Students wishing to join should write to Mr. F. K. J. Shenton, superintendent of the Literary Department, who will be happy to supply any information desired.

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A new feature has just been introduced into their scheme of practical education. The large house at the north end of the Palace, formerly tenanted by Sir Joseph Paxton, the designer of the world-famed glass house, has, for the present, been converted into a school of gardening. Mr. Edward Milner is the chief instructor in landscape gardening, and Mr. W. G. Head in practical gardening and floriculture.

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Here, also, at short intervals, some of the most accomplished specialists of the day lecture. The last course was delivered by the Rev. G. Henslow, M.A., F.L.S., Professor of Botany at Queen's College. The next course begins on October 5th.

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We may also mention that the Directors of the Crystal Palace Aquarium Company have taken into consideration the establishment of an Entomological Department for the study of the development of animal life as exemplified in the insects.

Technical Education has been well represented by the International Wool Exhibition. This has proved a pleasant and valued means of instruction to the many thousands who have watched the machinery in motion; and scores of youngsters, who this year or next will take up the new class subject, 'Elementary Science,' have been astonished at and delighted with the *electric* railway.

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Chief, however, among the Palace attractions for the young this summer has been Mr. Percy Williams' admirably conducted circus. It is seldom so good an all round troupe is retained at one establishment. The various members of the talented Madigan family form a valuable host in themselves. These, together with the clever and daring horsemanship of Mr. Bell, the pleasing and graceful performance of the Delavanti children on the wire, the carefully trained horses introduced by Mr. Antony, the wondrous acrobatic feats of M. Lavon, and the drolleries of the two merry-andrews—Rozner and Rice—make up an excellent performance. If any sad, dyspeptic friend is out of joint with the world we advise him to go and see Rozner in his stilt act—one of the funniest bits of harmless, laughter-provoking, comic business we ever witnessed. It is a thing to laugh at in one's dreams. We have pleasure in adding that the hour's enjoyment is not marred by the least vulgarity or breach of good taste. On the afternoon we were there we noticed the veteran journalist, Mr. Russell (of the *Schoolmaster)* and family enjoying themselves.

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We learn that considerable progress is being made in Persia as regards the spread of knowledge. Up to the present time education in that country has been confined to religious and clerical learning. A university, however, is now being established in Ispahan, at which European and Asiatic languages, together with arts and sciences, will be taught. The professors will be selected from European seats of learning.

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The last volume of the letters of the late Charles Dickens is now nearly ready for publication, and will be issued very shortly by Messrs. Chapman and Hall.

⁂

The two preceding volumes were very interesting, and the genial spirit of the great novelist breathed through every page of them. The *Letter to a Little Boy*, who had written to Dickens expressing his opinion as to the winding-up of *Nicholas Nickleby*, was of its kind perfectly unique, and showed what a kindly heart its writer possessed.

⁂

Miss Jane Lee, well known as an authority in Shaksperean matters, has just commenced a most stupendous task, that of translating the *Mahabarata*. This great Sanskrit epic, which contains about 80,000 lines, has never yet been rendered into English as a whole, though fragmentary versions have been issued. Miss Lee, however, intends giving us the entire work.

Professor Seeley, who is this year President of the Birmingham Historical Society, will deliver an address on 'The Study of History' before the members, in October, in which he will probably state his opinions on the subject. These are known to differ very much from those commonly held.

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We hear that Mr. Richard Grant White is engaged upon an exhaustive history of the music of the United States. Portions of the work will shortly appear in the pages of *Scribner's Monthly*, the journal which will soon be known as *The Century*.

⁂

Mr. Elliot Stock is about to publish a fac-simile of the 'Scottyshhe Kynge,' said to be the first printed English ballade. It will be introduced by a copious historical preface and notes.

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Messrs. Griffith and Farran's announcements for the coming season include, amongst others, the following works:—An edition of Gibbon's 'Decline and Fall of the Roman Empire,' in four volumes; 'Half-Hours of English History,' in four volumes; 'Shaksperean Tales in Verse'; new volumes in the Boys' Own Favourite Library; a revised and enlarged edition of the 'Boy's Own Toy-Maker'; and, with other books for children, 'Little Loving Heart's Poem Book,' by Margaret Eleonora Tupper, with forty illustrations and frontispiece by T. Pym.

⁂

The present generation of literary men have reason to feel thankful that their lot is not cast in the times 'when George the Third was king.' There has come down to us some record of how William Taylor, of Norwich, the foremost critic of his day, was paid for his contributions to *Phillips' Monthly Magazine*. For his translation of Burgess's *Leonore* he received 6s.; for a lengthy paper on so learned a subject as *Antinomianism*, 11s.; and for a translation of Klopstock's *Ode to Recovery*, the large sum of 2s. We do not know whether his profession as a *litterateur* ever led him to riches.

⁂

We hear that Messrs. Griffith and Farran have arranged to publish the American magazine, 'Our Little Ones,' in this country. This periodical, which has attained much popularity during its twelve months' existence across the Atlantic, is designed to suit the tastes of the very youngest children.

⁂

We have recently received the prospectus of the Browning Society, which has just been formed for the purpose of studying the poet's works. The inaugural meeting will be held on the 28th October, at University College, Gower Street, W.C., when the Rev. J. Kirkman, M.A., will read a paper on 'The Characteristics of Browning's Philosophy and Poetry.'

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It is understood that Mr. Tennyson is engaged upon a new dramatic poem, the title of which is not yet known.

Query Column.

*** *Communications for this column must reach the Office not later than the 15th inst., and should be addressed,* 'THE QUERY EDITOR' of the *Practical Teacher*, Pilgrim Street, Ludgate Hill, London, E.C. *Correspondents must in all cases remember to give their true names, not necessarily for publication, but as a guarantee of good faith, and for facility of reference.*

We are now receiving so many Queries that we shall be obliged for the future to limit each correspondent STRICTLY TO ONE *question.*

We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

When a correspondent wishes us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, he must, in all cases, accompany his query with a copy of Regulations up to date.

1. JOHN ANDERSON, Hexham.—See PRACTICAL TEACHER No. I. for solutions to your queries.

2. C. HUNT, Newark.—Solve the equation

$$2^{2x} + 2^{x+2} = 16896$$

$$\text{Since } 2^{x+2} = 2^x \times 2^2 = 4 \times 2^x$$
$$\text{and } 2^2{}_x = (2^x)^2, \text{ put } 2^x = y$$
$$y^2 + 4y = 16896$$
$$\therefore (y+2)^2 = 16900 = (130)^2$$
$$\therefore y+2=130 \text{ rejecting the negative value as irrelevant}$$
$$\therefore y=128 \therefore 2^x=2^7 \therefore x=7$$

3. ASSISTANT-MASTER, Henley-on-Thames.—I row from Henley to Marlow (8 miles) in 1 hour 4 min. (neglecting stoppages at locks), while it takes me $2\frac{2}{7}$ hours to return. At what rate do I row? and what is the rate of the current?

Let x be rate of rowing, y of current, in miles per hour rate going, for then he evidently has current with him, is $x+y$ miles.

He does $x+y$ m. per hour.

$$1 \text{ in } \frac{1}{x+y} \text{ hr.}$$

$$8 \text{ in } \frac{8}{x+y}$$

$$\therefore \frac{8}{x+y} = 1\tfrac{1}{15} = \tfrac{16}{15} \therefore 2(x+y)=15$$

$$\text{Similarly } \frac{8}{x-y} = \frac{16}{7} \therefore 2(x-y)=7 \quad 4x=22 \quad x=5\tfrac{1}{2} \quad 4y=8$$

$y=2$

4. SEAGAN, Leeds.—(1) Specially marked questions are set for acting teachers. They are easier than those set to second-year students. (2) Standard books on the subjects you name are:—*Music*, see former number of *Query Column. Political Economy*, by Mr. Fawcett; a more elementary manual by Marshall, called *Economics of Industry. Mechanics.*—Magnus.

5. 'DIEU ET MON DROIT,' Chobham.—We cannot say for certain. You had better drop a line to Messrs. Novello, and ask.

6. E. H. S., Sittingbourne.—*Science and Art Examination. Books Recommended. Third Stage.*—Honours. *Algebra*—Todhunter's larger work, Macmillan, 7s. 6d. *Geometry*—Todhunter's Euclid, Macmillan, 3s. 6d. *Trigonometry*—Todhunter's larger work, Macmillan, 5s. 6d. In the Algebra there would be several chapters which could be safely omitted. The Regulations are sufficiently definite on this point. *Fourth Stage.*—Use all the above books and in addition, *Geometry*—Wilson's Solid Geometry, Macmillan, not, however, adopting his treatment of Geometrical Conics. *Descriptive Geometry*—We believe there is a book in Weale's Series (Crosby, Lockwood & Co.) on Geometrical Drawing. If not, we cannot give a reliable recommendation. *Geometrical Conics*—Drew, Macmillan.

7. H. A. M., Clapham.—*A* was owner of $\frac{4}{17}$ of a vessel, and sold $\frac{3}{11}$ of $\frac{2}{9}$ of his share for £$\frac{400}{33}$; what was the value of $\frac{1\frac{2}{8}}{4\frac{1}{4}}$ of $\frac{2}{5}$ of the vessel? (*Barnard Smith.*)

$$\tfrac{3}{11} \text{ of } \tfrac{2}{9} \text{ of } \tfrac{4}{17} \text{ of a vessel is worth } £\tfrac{400}{33}$$

$$\therefore \text{the vessel is worth } £\frac{\cancel{11}}{\cancel{3}} \times \frac{\cancel{9}^{3}}{\cancel{2}} \times \frac{17}{\cancel{4}} \times \frac{\cancel{400}^{50}}{\cancel{33}}$$

$$\therefore \text{the vessel is worth } £850$$

$$\therefore \frac{1\frac{2}{8}}{4\frac{1}{4}} \text{ of } \tfrac{2}{5} \text{ is worth } £\frac{10 \times \cancel{4}}{\cancel{8}_{2} \times \cancel{17}} \times \frac{\cancel{2}}{\cancel{5}} \times \cancel{850}^{10}$$

i.e. £100

8. H. A. M., Clapham.—The circumference of a circle is to its diameter as 3.1416 : 1; find (in feet and inches) the circumference of a circle whose diameter is $22\frac{1}{2}$ feet. (*Barnard Smith.*)

Answer evidently is 22.5×3.1416

$$\begin{array}{r} 22.5 \\ \hline 157080 \\ 62832 \\ 62832 \\ \hline 70.68600 \\ 12 \\ \hline 8.232 \end{array}$$

Answer 70 feet 8.232 inches.

9. IRVING, SENIOR, Earlsheaton.—A farmer mixes wheat at 38s. 6d., 40s. 6d., 42s. 9d., 45s., and 47s. together so as to form 78 qrs. of a mixture worth 44s. per qr.; how much must he take of each? (*Pupil Teachers*, Third Year, Didsbury.)

Suppose him to take a, b, c, d, e qrs. of each respectively.

$$\text{Then} \quad a+b+c+d+e=78$$
$$a(38\tfrac{1}{2})+b(40\tfrac{1}{2})+c(42\tfrac{3}{4})+d(45)+e(47)$$
$$=(a+b+c+d+e)\times 44$$
$$=78\times 44=3432$$

$$\text{Thus then} \left\{ \begin{array}{l} a+b+c+d+e=78 \\ 154a+162b+171c+180d+188e=13728. \end{array} \right. \quad (1)$$

These are all the equations obtainable from the *data* of the problem, so that they are indeterminate.

Eliminating a by multiplying the first equation by 154, and subtracting from the second.

$$8b+17c+26d+34e=1716 \quad (2)$$

An infinite number of solutions can now be deduced, c, d, e being chosen perfectly arbitrarily under the conditions that all should be positive, and that

$$\left. \begin{array}{r} c+d+e<78 \\ 17c+26d+34e<1716 \end{array} \right\} \quad (3)$$

b is found from (2) and a from (1).

These limitations, which, of course, are simply the Algebraical expression of the fact that the values of a and b, deduced from the values of c, d, e, must be positive, may be further simplified.

Evidently c must be less than 78.

Evidently also d and e have their greatest values when c and e, and c and d respectively are simultaneously zero—*i.e.*, the greatest values of d and e are given by $\frac{1716}{26}$ and $\frac{1716}{34}$.

Hence a systematic process for solution is roughly as follows: Choose for e any value less than $\frac{858}{17}$. Substitute this value in the two inequalities (3). Suppose that the second of these thus becomes $17c+26d<x$. Choose for d any value less than $\frac{x}{26}$. Substitute this value, and suppose that we thus get $17c<y$. Choose for c any value less than $\frac{y}{17}$. Substitute these values in (2) and we have (8), in (1) and we have a.

10. R. B., Prudhoe.—A bankrupt has book-debts equal in amount to his liabilities, but on £6000 of them he can only recover 13s. 4d. in the pound, and the expenses of the bankruptcy are 5% on the book-debts; if he pay 13s. in the pound, what is the amount of his liabilities? (*Barnard Smith.*)

Suppose the liabilities are £2000.

Then bankruptcy expenses are £100.

Also, as he pays 13s. in the £, he pays £1300.

$\therefore$ Assets are £1400.

Also his book-debts are £2000, and these are divided into two parts, on one of which he gets only $\frac{2}{3}$ (*i.e.* 13s. 4d. in the £).

Hence $\frac{2}{3}$ one part + other part = £1400.

one part + other part = £2000.

$\therefore$ $\frac{1}{3}$ first part = £600.

$\therefore$ first part = £1800.

But in the sum the first part is £6000 $\therefore$ instead of £2000 the liabilities are actually $\dfrac{\overset{1000}{\cancel{6000}}}{\underset{3}{\cancel{1800}}} \times 20\cancel{00} =$ £6666 13s. 4d.

It is usual to remember that this method, which may be called the 'method by trial,' is always available when the problem results in a simple equation if the sum contains merely ratios and percentages.

11. BONA FIDE, Kidsgrove.—I bought paper at the rate of 3s. 7½d. for 5 quires, and sold it so as to gain as much on the cost of 32 quires as 3 quires were sold for. At what rate did I sell the paper per quire?

Referring to the rule at the end of last question, we see that the method by trial is available here. Let us then suppose that we sell the paper at 8d. per quire.

32 quires sell for 256 pence.
3 " " 24 "

But we gain the selling price of 3 on 32 $\therefore$ 32 quires are bought for 232 pence.

$$\frac{\overset{29}{\cancel{232}}}{\underset{4}{\cancel{32}}} \times 5 \text{ pence.}$$

i.e. $\frac{145}{4}$ pence.

But actually 5 quires are bought for $\frac{87}{2}$ pence instead of being sold at 8d. per quire $\therefore$ they are sold for

$$8 \times \frac{\dfrac{\overset{3}{\cancel{87}}}{\cancel{2}}}{\dfrac{\overset{5}{\cancel{145}}}{\underset{2}{\cancel{4}}}} = \frac{8 \times 6}{5} = 9\tfrac{3}{5}\text{d.}$$

We can make our original assumption as large as we like—£1,000,000 per quire, say—and the answer will always be the same. You ask for a mention of improvements in writing, style, etc., necessary for Civil Service. Care will remedy all your writing errors, for at present your hand is scarcely clerkly; but excuse our suggesting that it is customary to use inverted commas for quotations from standard authors, etc., and therefore the sentence 'Can you favour me with the answer this month?'—though, alas! it is all too familiar to us—is scarcely worth the distinction of commas.

12. MAGISTER, Dudley.—We do not know whether there is any foundation in fact for the 'Wreck of the Hesperus.' We should think it probable that some such event as is detailed in the last verse, not uncommon in the history of wrecks, suggested the poem.

We know of no reason which induced the owner of the ship to christen it Hesperus. The word of course is the same as Vesper (v = h), the evening star.

The sea round the coasts of South America was called the Spanish Main, more especially that part near Peru, and the Caribbean Sea.

Your next question we cannot answer, owing to 'ignorance, pure ignorance.' Nor can we tell definitely what is meant by the 'Reef of Norman's Woe.' Cape Norman is a headland on the W. coast of Newfoundland, at the W. entrance of the narrow bay of Mauco, twenty leagues from Cape Ferrol, in N. lat. 51° 40′. There is also Norman's Island in the W. Indies, eighteen miles E. of St. John, in N. lat. 18° 20′. Also a river falling into the Hudson, two-and-a-half miles S. of Albany, is called Norman's Creek. All these would be well known to an American, and may have suggested the name. Or there may actually be a dangerous reef near the first, known by the name of Norman's Reef. This is the most probable suggestion we have, taking into account the sleetstorm which is mentioned.

13. R. K. S., Clapton.—In query No. 22, September, the following passage occurs:—'To get your answer, £2 10s., by conjectural emendations would be waste of time.' John Wilson, Esq., M.A., F.R.S.E., of Bannockburn Academy, has been kind enough to do the conjectural part for us. His suppositions, which contain nothing in themselves improbable, make the completion of the problem as follows:—

$342\frac{6}{7}$ by sea	at ¾d. per mile =	£1	1	$5\frac{1}{7}$
$102\frac{6}{7}$ by rail	at 2d. per mile =	0	17	$1\frac{5}{7}$
$34\frac{2}{7}$ by coach	at 4d. per mile =	0	11	$5\frac{1}{7}$
	Total cost of journey	2	10	0

We shall always be ready to give sincerest thanks to any who will help us in this manner.

We have since received information that the problem was originally set as emended by Mr. Wilson, in the Cambridge Local Examination for 1875.

R. K. S. should have been more careful.

14. H. G., Wigan.—When is the time past noon ⅘ the time to midnight?

In other words—'Divide 12 into two parts which are in the ratio of 4 to 5.' Now 9 thus divides into 4 and 5; 1 into $\frac{4}{9}$ and $\frac{5}{9}$; 12 into $\frac{4}{9} \times 12$, and $\frac{5}{9} \times 12$. Hence the answer is $\frac{16}{3}$ hours past 12, or 5 hours 20 minutes.

15. A. H., Brighouse.—*Further* is the comparative of *forth*; *Farther* is the comparative of *far*, the *th* having crept in from false analogy with forth. The uses in English are in some cases fairly well marked, in other cases very confused. *Examples.*—'Further than this, I cannot say anything' (*farther* is not correct here). 'Furthermore.' There is no general rule to guide you in the choice.

16. M. EVANS, Machynlleth.—I can travel 187 miles by rail and 15 miles by coach in 11 hours; or 88 miles by rail and 6 miles by coach in 5 hours. Find the rate of travelling by rail and by coach.

Suppose x miles per hour by rail, y by coach.

x miles in 1 hr.

1 " $\frac{1}{x}$ hr.

187 " $\frac{187}{x}$ hrs.

Hence easily $\quad \dfrac{187}{x} + \dfrac{15}{y} = 11 \quad (1)$

$$\frac{88}{x} + \frac{6}{y} = 5 \quad (2)$$

Multiply (1) by 8 (2) by 17 and subtract

$$\frac{120 - 102}{y} = 88 - 85 \quad \therefore \frac{18}{y} = 3 \quad \therefore y = 6$$

Substituting this value in (2) $\dfrac{88}{x} = 4 \quad \therefore x = 22$

This is therefore not a quadratic, but a simple simultaneous equation.

17. NERO, Pontypridd.—Find the value of y when the fraction

$$\frac{x^3 - (2y - 1)x^2 + x + 1}{x^3 + (2y + 1)x^2 + 3x + 1}$$

admits of reduction and reduce it.

When two expressions have a common factor it is obvious that it must also be a factor of their difference. Thus if these two have a common factor it must also be a factor of

$$\{x^3 + (2y+1)x^2 + 3x + 1\} - \{x^3 - (2y - 1)x^2 + x + 1\}$$

or $4yx^2 + 2x$. Hence it is obvious that if they have a factor it is $2xy + 1$. As this divides both expressions $x = -\dfrac{1}{2y}$ must be a root of $x^3 - (2y - 1)x^2 + x + 1 = 0$

$$\therefore -\frac{1}{8y^3} - \frac{(2y - 1)}{4y^2} - \frac{1}{2y} + 1 = 0$$
$$\therefore -1 - 2y(2y - 1) - 4y^2 + 8y^3 = 0$$
$$\therefore -1 - 4y^2 + 2y - 4y^2 + 8y^3 = 0$$
$$\therefore 8y^3 - 8y^2 + 2y - 1 = 0$$

This gives the three values for y, $y = 1$ is not a root of this equation. Nor does the fraction admit of reduction when $y = 1$, so that the book (Stewart's *Exercises in Algebra*) is entirely wrong.

To solve the equation (1) put $2y = z$

$$z^3 - 2z^2 + z - 1 = 0$$

(2) put $z = p + \frac{2}{3}$

$$\begin{aligned} p^3 + 2p^2 + \tfrac{4}{3}p &+ \tfrac{8}{27} \\ - 2p^2 - \tfrac{8}{3}p &- \tfrac{8}{9} \\ p &+ \tfrac{2}{3} \\ &- 1 \\ \hline p^3 - \frac{p}{3} - \tfrac{25}{27} &= 0 \end{aligned}$$

(3) put $p = r + s$ and $rs = \frac{1}{9}$

$$r^3 + s^3 + 3rs(r + s) - \tfrac{1}{3}(r + s) - \tfrac{25}{27} = 0$$
$$r^3 + s^3 - \tfrac{25}{27} = 0$$
$$\therefore r^3 + \frac{1}{729r^3} - \tfrac{25}{27} = 0$$

This is an equation for r^3, whence r

$$\text{and } y = \tfrac{1}{2}\left\{ r + \frac{1}{9r} + \tfrac{2}{3} \right\}$$

It is thus sufficiently obvious that y has no integral value. One real root lies between 1·5 and 2.

We rather suspect that the sum itself is a misprint for $\frac{x^3 + (2y - 1)x^2 + x + 1}{x^3 + (2y + 1)x^2 + 3x + 1}$ in which case it will be found that y has only one value, unity, and $x + 1$ is the common factor.

18. P. T., of 2nd year, who sends some remarkable queries, needs to be reminded that we never answer any unaccompanied by real name and address of sender.

19. W. BOYD, Irvine.—Both your letters reached us. As the first was *dated* Aug. 22nd, you need scarcely have been surprised at not being answered in the Sept. 'PRACTICAL TEACHER.'

Harmonic Vibrations is a wide term. It is used of the oscillatory motion of a particle moving in a straight line under the action of a force (emanating from a fixed point in that line) which varies inversely as the distance of the particle from that point. This we rather suspect is the meaning here—not musical vibrations at all. We cannot tell for certain until we see a specimen of the papers under the altered regulations.

20. JULIA GREY, St. Helen's.—Your best plan is to write to the Secretary of the College you wish to enter. He will be happy to give you any information.

21. F. S., Romford.—What is the price of meat now when we get 4 lbs. less for £1 than we did when meat was 2d. a lb. cheaper?

We do not think an arithmetical solution of this is possible. By Algebra, of course, it is instantaneous, for we have, if meat was xd. per lb.,

$$\frac{240}{x} = \frac{240}{x+2} + 4 \quad \therefore\ x(x+2) = 120$$

$$\therefore\ x^2 + 2x - 120 = 0 \quad (x - 10)(x + 12) = 0 \quad x = 10 \text{ or } -12$$

Hence answer is 1s. In this we note that the problem leads to a Quadratic Equation. We should thus be led to draw the *à priori* inference that there is no fair arithmetical method of doing it. Of course we may be mistaken in this.

22. W. R. H., Dorset.—At an Agricultural Show 131 horses compete in 9 classes; the numbers entered in each class are 18, 13, 15, 16, 10, 11, 12, 15, 21 respectively, and the corresponding prizes are 20, 18, 16, 15, 14, 12, 10, 8, 6 pounds respectively. Assuming the average value of the horses in each class to be proportional to the prize offered, and the average value of those in the fourth class to be £60, find the average value of each of the 131 horses.

What the *average* value of *each* of a certain number of horses means, we are unable to conjecture. Allowing for our ignorance, the working of the sum is as follows:—

Value in fourth class is £60.
Prize in fourth class is £15.

$\therefore$ to get value in any class multiply the prize by $\frac{60}{15}$, *i.e.*, 4.
Hence values are 80, 72, 64, 60, 56, 48, 40, 32, 24,
and numbers are 18, 13, 15, 16, 10, 11, 12, 15, 21.

$\therefore$ average value of *all* the 131 is, by the ordinary rule for averages—

$$\frac{80 \times 18 + 72 \times 13 + 64 \times 15 + 60 \times 16 + 56 \times 10 + 48 \times 11 + 40 \times 12 + 32 \times 15 + 24 \times 21}{131}$$

A fraction which, simplified, will give the answer in £. Those are at liberty to do this series of multiplications who have time at their disposal.

23. P. P., Bow.—Determine the points whose co-ordinates satisfy the pair of equations

$$\frac{x}{a} + \frac{y}{b} = 1 \quad (1)$$

$$\frac{x}{b} + \frac{y}{a} = 1 \quad (2)$$

As a general rule, the intersections of the curves $\phi(x, y) = 0$, and $\psi(x, y) = 0$ are given by solving

$$\left.\begin{array}{l}\phi(x, y) = 0 \\ \psi(x, y) = 0\end{array}\right\}$$

as simultaneous equations. Proceeding then in the ordinary way,

Subtracting (2) from (1) and cancelling $\frac{b-a}{ab}$ we get—

$$x = y \quad \therefore\ \frac{x}{a} + \frac{x}{b} = 1 \quad \therefore\ x = \frac{ab}{a+b}$$

Hence the answers you give are entirely wrong.

24. R. GIBBONS, Stockport.—If set at the Pupil Teacher's Examination, your problem will appear in the back numbers. Look carefully, and if you fail to find it, write again.

25. D. PENN, Oxford.—In how many different ways can a first and second prize be given among 10 boys, no boy to hold both?

This is a problem in Permutations, and not, as you think, a conundrum.

The first prize may obviously be given in 10 ways, because each of the 10 boys is eligible. This being assigned, there are 9 boys left to whom the second may be given. Hence, altogether, the two may be given in 10×9 or 90 ways. Thus your answer $(10+9$ or $19)$ is wrong.

The answer you give to your second sum is incomprehensible nonsense. Your author would do well not to tackle a subject so remarkably difficult as this last sum proves Permutations to be. It is against our rule to work the sum, as it is your second. It is, however, no harder than the last, and the right answer is 6×5 or 30.

26. WHEATLEY, Cotmanhay.—Find the value of

$$\frac{1}{10^3} \times \left(1 - \frac{3}{10^2} + \frac{3 \times 4}{1 \times 2} \times \frac{1}{10^4} + \frac{3 \times 4 \times 5}{1 \times 2 \times 3} \times \frac{1}{10^6}\right)$$

expressing it (1) as a decimal, (2) as a fraction.

$$1 = 1·000$$

$$\frac{3 \times 4}{1 \times 2} \times \frac{1}{10^4} = \frac{6}{10^4} = ·0006$$

$$\frac{3 \times 4 \times 5}{1 \times 2 \times 3} \times \frac{1}{10^6} = \frac{1}{10^5} = ·00001$$

$$1·00061$$

$$\frac{3}{10^2} = ·03$$

$$·97061$$

Hence answers are ·00097061, *i.e.*, $\frac{97061}{100{,}000{,}000}$

27. ROMEO, Airdrie.—(We answer only one of your two. If I sell a horse for £62, and a cow for £26, I gain 10 per cent. on the original cost of the two; but if I sell the horse for £63, and the cow for its original price, I lose 10 per cent. Find the original cost of both.

In first case, selling price £62 + 26, *i.e.*, £88, is a gain of 10 % on buying price $\therefore$ buying price is $\frac{100}{110}$ of £88, *i.e.*, £80.

In the second case, 10 % is lost on the two.

$\therefore$ they are sold at $\frac{90}{100}$ of £80, *i.e.*, £72. But the horse is sold for £63 $\therefore$ the cow's original value is £72 − £63 = £9.

$\therefore$ the horse's original value was £80 − £9 = £71.

28. W. BOSTOCK, Chester.—(We answer the harder of your queries.) A train 140 feet long, travelling at the rate of 40 miles an hour, passes another train 125 feet long travelling in an opposite direction in 4 seconds. At what rate did the second train travel?

We advise you to refer to back numbers for a few other illustrations of the method of doing these 'train-sums.' They are best considered as an example of *relative motion*, *i.e.*, imagine one train at rest, and the other moving with a velocity equal to the sum of the velocities of the trains (the *difference* if they are travelling in the *same* direction). Hence 140 + 125 feet are passed over, at this total rate, in 4 seconds.

$66\frac{1}{4}$ feet per second.

$$\therefore\ \frac{66\frac{1}{4}}{88} \times 60 \text{ miles per hour.}$$

But the other train moved at 40 miles per hour $\therefore$ the second train moves at

$$\frac{66\frac{1}{4}}{88} \times 60 - 40 \text{ miles per hour}$$

$$\text{or } \frac{3975 - 3520}{88} \text{ or } \frac{455}{88} \text{ or } 5\tfrac{15}{88} \text{ miles per hour.}$$

29. INQUIRER, Tunstall.—With regard to your second query, we may say that henceforth no advertisement will be inserted in the body of the journal.

A man bought a horse and carriage for £100, and sold the horse at a gain of 50 per cent. on its prime cost, and the carriage at a loss of 25 per cent., thus gaining 5 per cent. on this whole outlay. What were the buying prices of the horse and carriage respectively?

The following method of doing such sums is practically Algebra, but we know of no other.

$$\begin{array}{llcll} & \text{Horse's value} & + & \text{carriage value} & = £100. \\ \frac{150}{100} & \quad " & + & \frac{75}{100} \times \quad " & = £105. \\ \text{or } \frac{3}{2} & \quad " & + & \frac{3}{4} \quad " & = £105. \\ \text{or } 2 & \quad " & + & \quad " & = £140. \\ \text{But} & \quad " & + & \quad " & = £100. \end{array}$$

$\therefore$ horses's value is £40
and carriage's value, £60.

30. UNDERGRAD., Walham Green.—For Mathematics for the 1st B.A. Examination at London use as follows:—*Algebra* and *Trigonometry*, Hamblin Smith. *Conic Sections*, Todhunter, selected chapters. *Geometry*, Todhunter. Study carefully the appendix, and work as many of his 600 examples as you can; also Wilson's Solid Geometry. Omit all about the Geometrical treatment of Conics. See also advertisement on third page of our cover.

31. INCOGNITO, Liversedge.—A triangular space, which is also isosceles, is traversed by a fence parallel to the hypotenuse which divides the triangle into two equal parts. The length of the fence is 30 yards; find the sides of the triangle (*Certificate Examination*, 1880).

The area of the large triangle is double the area of the smaller triangle formed by the fence $\therefore$ as areas are as 2 : 1, corresponding sides are as $\sqrt{2}:1$ (Euc. vi. 19). But the fence is 30 yards $\therefore$ the base of the triangle is $30\sqrt{2}$ yards. We cannot find the other sides without having some angle given. We rather suspect that you were told that the vertical angle is a right angle, otherwise it is strange to use the term hypotenuse. If so, if x be the other side, we have by

$$\text{i. } 47, \left.\begin{array}{l} x^2 + x^2 = 30^2 \times 2 \\ \therefore x^2 = 30^2 \\ \therefore x = 30 \end{array}\right\}$$

32. G. FOSTER, Anthorpe. — Write to the Tonic Solfa Agency, Warwick Lane, London, E.C., for their catalogue of musical publications.

33. F. E. S., Reading.—Refer to the advertisement at the top of page 315 in our last issue. Mr. Quick's book is all you need.

34. A CONSTANT READER, Chwilog.—You surely cannot expect us to answer all your six questions. Your best plan, in answer to No. IV., is to take the advice previously given to G. Foster (32), and also to write to Messrs. Novello. We have previously answered you in part by recommending a book on Musical Composition.

35. JAMES MACINTOSH, Bervie.—We have, unfortunately, mislaid your Query.

—o—

Scholarship Examination, 1881.

Geography and History.

Three hours allowed for this paper.

MALE AND FEMALE CANDIDATES.

(Candidates must not answer more than *one* question in any Section.)

Geography.

SECTION I.

Draw a map of—
(*a*) England, south of the Mersey and Humber, showing the chief river basins;
Or, (*b*) The Iberian Peninsula;
Or, (*c*) North America.

SECTION II.

1. Give the full meaning of the terms tropic, meridian, longitude, solstice, coral-reefs, with appropriate diagrams in each case.
2. Name the chief bays, capes, river-mouths, and sea-ports between the mouths of the Forth and the Thames.

SECTION III.

1. Describe the positions of Iceland, Chios, Heligoland, Minorca, and Cyprus, and name the country to which each belongs.
2. Into which of the British and Irish ports would flax, jute, cotton, wool, hemp, and hides be chiefly imported? Discuss the convenience of the ports for the districts of manufacture.
3. Enumerate the chief commercial towns of France and the chief rivers of Germany, and give a full description of *one* of the latter.

SECTION IV.

1. Describe the position and state briefly any remarkable events in history connected with Delhi, Quebec, St. Helena, Plassy, and Mecca.
2. Name the chief articles of commerce supplied to Great Britain by Canada, Jamaica, Ceylon, Newfoundland, and New South Wales.

SECTION V.

1. Enumerate the mountain systems of America, and give a full description of one of them.
2. Name the chief native races in the British Colonies and possessions, and describe the habits and character of *one* of these races.
3. Give a full description of the North Pacific Ocean.

History.

SECTION I.

Arrange in chronological order and give the dates of the following events:—The death of Mary Queen of Scots; the battles of Cresy, Flodden, and the Boyne; the death of Canute and Henry VII.; the introduction of Printing; the peace of Amiens and of Ryswick; the abolition of the Slave Trade; the signing of Magna Charta and of the Solemn League and Covenant.

SECTION II.

1. What do you know of Norman influence in Great Britain before the Norman conquest?
2. What feudal relations existed between England and Scotland under Edward the Elder?
Trace these relations in subsequent reigns, and show what use Edward I. made of them.
3. In what reign were English possessions on the Continent most widely extended? Sketch briefly their gradual loss.

SECTION III.

1. Enumerate briefly the chief historical events connected with the Tower of London *or* Holyrood House, and give a brief account of one of them.
2. In which of the Tudor and Stuart reigns were England and Spain brought into political connection, and how?
3. Name, with dates, the principal events connected with Naseby, Derby, Plymouth, Worcester, Canterbury, and Stirling.

SECTION IV.

1. Explain briefly the terms Lollards, Roundheads, Regicides, Pilgrim Fathers, the Cabal; and name the reigns to the history of which each belongs.
2. Write a brief account of one of the great statesmen under the Brunswick dynasty.
3. What important consequences followed upon the battles of the Nile and Quebec? Name some of the chief differences between the weapons of war employed in these battles and in modern warfare.

ANSWERS.—GEOGRAPHY AND HISTORY.

Geography.

SECTION II.

1. *Tropic.*—From Greek *trepo* (τρεπω), I turn. The parallels at 23° 28' on each side of the Equator are called *Tropics;* the one N. of Equator, the Tropic of Cancer; the one S. of Equator, the Tropic of Capricorn. They are so called because the sun recedes from its vertical position above the Equator till it reaches these lines and then turns back and approaches it again.

Meridian.—From *meridies*, mid-day. All places directly N. or S. of each other have their noon at the same time. An imaginary half-circle drawn from pole to pole and passing through all such places is called a *meridian.*

Longitude.—Length. Distance from a given place E. or W. The places which have noon at the same time are said to be in the same longitude, and the meridians are called meridians of longitude. Different countries select different places from which to reckon. England takes the meridian which passes through Greenwich, and all meridians which do not pass through it are therefore E. or W. of Greenwich, and are said to be in E. or W. longitude.

Solstice.—*Sol*, the sun; *sto*, I stand. The time when the sun reaches the Tropics, and seems to stand still before it again approaches the Equator, is called a Solstice.

Coral reefs.—Coral reefs are chains of rocks projecting above the water in a jagged ridge, and are due to the growth of coral either on submerged land or on land nearly at the level of the sea. They are of two kinds, *barrier* and *fringing;* the former being at a distance, the latter close and parallel to the shore. Other coral islands are *Atolls.*

2. *Bays.*—Firth of Forth, Bridlington Bay, Wash, Mouth of Thames.

Capes.—St. Abb's Head, Flamborough Head, Spurn Head, Lowestoft Ness, the Naze, Foulness.

River mouths.—Forth, Tweed, Tyne, Wear, Tees; Humber, receiving the Ouse and Trent; Thames. *Less important River mouths:* Coquet, Witham, Welland, Nen, Gt. Ouse, Yare, Stour, Chelmes.

Ports.—Leith, Granton, Berwick, Blyth; Tyne ports, including Newcastle and North and South Shields; Sunderland, Seaham, Hartlepool, Stockton, Whitby, Hull, Grimsby, Yarmouth.

SECTION III.

1. *Iceland.*—An island in the N. Atlantic Ocean, between 64° and 68° N. lat. and 12° and 26° W. long. A small portion is within the Arctic Circle. Belongs to Denmark.

Chios.—Island off W. coast of Asia Minor in Grecian Archipelago. E. long. 26°, N. lat. 38½°. Belongs to Greece.

Heligoland.—Island about thirty-six miles N.W. of the mouth of the River Elbe, and off the coast of Denmark. Belongs to England.

Minorca.—One of the Balearic Isles, in the Mediterranean Sea, off the east coast of, and belonging to Spain. N. lat. 40°, E. long. 4°.

Cyprus.—Island in the Mediterranean Sea, south of Asia Minor. N. lat. 35°, E. long. 32° to 35°. Belongs to England.

2. *Flax.*—Into Dundee, Hull, Belfast. Linen is manufactured largely in Dundee and Belfast, and Hull is the nearest port for the West Yorkshire towns—Leeds, Barnsley, etc.—where it is manufactured in England.

Cotton.—Glasgow, Liverpool. In Scotland the manufacture is carried on chiefly at Glasgow and Paisley, and Liverpool is the nearest port for Manchester and the other manufacturing towns of Lancashire.

Jute and Hemp.—Needed for ropes, etc. Manufacture carried on at nearly all the ports, and imported into the principal ports, Glasgow, Belfast, Dundee, Newcastle, Portsmouth, Plymouth, Hull. Jute principally to Dundee.

Wool.—Largely imported from Australia, New Zealand, and Cape Colony. Ships arrive principally at London and Southampton from these places, both considerable distances from seats of manufacture. German wool landed at Hull.

Hides.—Principally London, tanning being carried on in Bermondsey (Southwark).

3. *Commercial Towns of France.*—The ports are Marseilles, Havre, Bordeaux, Nantes, Rochelle, Boulogne, Dunkirk. The inland commercial and manufacturing towns are Lyons, Nismes, Paris, Rouen, St. Quentin, Lille, Troyes, St. Etienne, and Cambray.

Rivers of Germany.—Niemen, Pregel, Vistula, Oder, Elbe, Weser, Ems; Rhine, with tribs., Neckar, Mayn, Lalin, Ruhr, Lippe, Moselle; Danube, trib. Isar. The Rhine does not belong wholly to Germany, its source and upper course being in Switzerland, and its mouth in Holland. It enters Germany near Basle, and flows northwards between the Vosges and the Black Forest. Its course is impeded by islands, and its declivity being great, the river is very rapid. Several rapids are formed by the narrowing of its course. At Mentz its course is W. to Bingen, and then N.W. to the North Sea. Before it leaves Germany it reaches a flat country, and is half a mile in breadth. Its scenery is very beautiful, its banks presenting every variety of landscape. Strasbourg, Wiesbaden, Leyden, Utrecht, Stuttgart, Frankfort, and Heidelberg are other towns on the river and its tributaries.

SECTION IV.

1. *Delhi.*—On the river Ganges, in the division of India called the Punjaub. Formerly the capital of the Great Mogul Empire, and celebrated in the modern history of India for the revolt, siege, and capture, in 1857, during the Indian Mutiny.

Quebec.—On a small promontory near the junction of the Clandiere with the St. Lawrence. Founded by the French in 1608, and belonged to them till captured by General Wolfe, in 1759. The capture was remarkable, owing to the strength of its fortress, and its inaccessibility.

St. Helena.—Situated in S. Atlantic Ocean, in S. lat. 16°, and W. long. 6°, about 1,200 miles from the W. coast of Africa. Celebrated as the residence of Napoleon I. from 1815 to 1821. His body was removed in 1840.

Plassy.—Eighty miles north of Calcutta, on a trib. of the Hooghly. Great victory of Clive over Surajah Dowlah, after the incarceration of the English in the Black Hole of Calcutta, 1757.

Mecca.—About sixty miles from the Red Sea, in the W. of Arabia. N. lat. 21°, E. long. 21°. Birthplace of Mahomet. Flight of Mahomet, 622 A.D.

2. *Canada.*—Timber, wheat, flour, potash and pearlash, preserved meats and fish, skins, cattle.

Jamaica.—Sugar, rum, coffee, logwood, allspice, arrowroot, ginger.

Ceylon.—Coffee, cinnamon and other spices, cocoa-nut (oil and fruit), precious stones.

Newfoundland.—Dried fish, fish oil. herrings, cod, salmon, and other fish.

New South Wales.—Gold, copper, wool, hides, tallow, preserved meats.

SECTION V.

1. In S. America: the Andes, Brazilian Mts., Mts. of Guiana. In N. America: the Rocky Mountains, the Cordillera of Mexico, the Alleghanies, the Ozark Mts., Cascade Mts., and Maritime Range. The Andes extend from the extreme S. of the continent of America to the N., where they are connected with the mts. of Central America. They form in the S. the W. coast line, and are never more than 100 miles inland. In 19° S. lat. the range subdivides, the E. part being called the Eastern Cordillera, and the W. part the Western Cordillera. Mt. Sorata and Mt. Illimain, the highest mts. in the New World, are in the E. Cordillera. Numerous volcanoes are found in the range, especially near the Equator, near which also is the tableland of Quito. The range is here further subdivided, and sometimes goes under the name of the Mts. of New Granada. The Andes contain the sources of the Amazon and the Orinoco, forming together the largest fresh-water system in the world.

2. *Malta.*—Maltese.

India.—Hindoos, although not strictly aborigines, are regarded as such by English.

Ceylon.—Singhalese.

Hong Kong.—Chinese.

Cape Colony.—Hottentots, Bushmen, Kaffirs, and Fingoes.

Natal.—Kaffirs.

Western Africa.—Negroes.

Mauritius.—Coolies, Negroes, and Malays.

British N. America.—Red Indians.

Australia.—Australian Negroes.

New Zealand.—Maories.

The Maories belong to the Malay variety of the human family, and are strong, well-built, and muscular, resembling in appearance deeply-coloured gipsies. Till New Zealand was colonized by the English, they were cannibal savages, eating their prisoners and those slain in battle. Since 1843 they have made great progress in civilization, and life and property are as safe with them as in England. They have all embraced Christianity, and voluntarily placed themselves under British rule

Most of them are engaged in agricultural pursuits, residing principally in North Island. Their numbers, however, are gradually decreasing.

3. The Pacific Ocean is the largest expanse of water on the globe, covering an area estimated at 50,000,000 sq. miles. Of this, the *N. Pacific* occupies twenty millions. At the Equator it is 12,000 miles across, and on all the other sides it is surrounded by land, with the exception of the opening into the Arctic Ocean at Behring's Strait, which is thirty-six miles across. On the E. it is bounded by N. America, and on the W. by Asia. Its chief branches are on the W., the Sea of Kamtschatka, the Sea of Okhotsk, Sea of Japan, Yellow Sea, and Chinese Sea; and on the American side there are the Gulf of California and the Gulf of Panama. On the E. the land is high, and furnishes no large river to the ocean; while in Asia the mountains are a considerable distance from the coast, and the Amoor, Yang-tse-kiang, Hoang-ho, and Meinam, four of the largest rivers of the Old World, run into it. A marked feature of the W. Pacific also is the large number of islands which are spread over its surface. The principal groups lying nearest to Asia are the Kurile Islands, Saghalien, Japan Islands, Formosa, Hainan, Philippine Islands, Caroline Islands. The Alentian Islands and Vancouver Island lie near America, and the Sandwich Islands are midway between the two continents.

History.

SECTION I.

Death of Canute	A.D.	1035
Signing of Magna Charta	,,	1215
Battle of Crecy	,,	1346
Introduction of Printing	,,	1471
Death of Henry VII.	,,	1509
Battle of Flodden	,,	1513
Death of Mary, Queen of Scots ...	,,	1587
Signing of Solemn League and Covenant...	,,	1638
Battle of the Boyne	,,	1690
Peace of Ryswick	,,	1697
Peace of Amiens	,,	1802
Abolition of Slave Trade	,,	1833

SECTION II.

1. Ethelred the Unready married Emma, the daughter of Richard I., and sister of Richard II., the reigning Duke of Normandy. Ethelred's cruelty caused an invasion by the Danes, who were so successful as to cause him to flee to Normandy. From this time dates the influence of Normandy in England. After the death of Edmund Ironsides, Canute tried to strengthen his position, and to ward off the hostility of Richard by marrying Ethelred's widow, whose children were now being brought up in Normandy. One of these, Edward the Confessor, became King of England on the death of Hardicanute, 1042, and he alienated the affections of his Saxon subjects by the favour which he showed to the Nomans whom he had brought over with him when he ascended the throne. Norman warriors were stationed in the fortresses, Norman priests were appointed to vacant benefices, the court was surrounded by Norman courtiers, and a Norman chancellor was also at the head of affairs. William of Normandy also paid a visit to the king, making himself known to many of the nobles. It is said, too, that William had obtained from Edward a promise of the crown, and that Harold also, the son of Godwin, the chief of the Saxon nobles, had acquiesced in the arrangement by which the throne should be given to William.

2. The Scots, the inhabitants of Strathclyde, are said to have chosen Edward the Elder as 'their father, lord, and protector.'

In the reign of Edmund I., Northumbria was lost to the Danes, but afterwards recovered and given to Malcolm, King of Scotland, on condition that he should become his vassal, and aid him in defending the country against all invaders. Scotland refused to acknowledge this relationship when Canute became king, and consequently he advanced with an army to subdue it, succeeding in his efforts.

In the reign of William Rufus, Malcolm made two unsuccessful attempts to free himself, but after the first he was compelled to do homage, and in the second he was killed. In 1174 William, King of Scotland, was made prisoner, and only released on confessing himself a vassal.

It will thus be seen that on several occasions from the time of Edward the Elder the Scots had voluntarily, or by compulsion, acknowledged the King of England as their feudal superior. Edward I. made use of this when he refused to arbitrate between Bruce and Baliol till his claims had been allowed.

3. In the reign of Henry II. Anjou, Maine, Touraine, Normandy, Poiton, Saintonge, Auvergne, Perigord, Limousin, Angoumois, and Guienne then belonged to England.

The death of John's nephew, Arthur, was made a pretext by the King of France for the invasion of John's French dominions, an l in 1204–5 Normandy, Anjou, Maine, Touraine, and Poiton submitted to him. At the truce which followed shortly, Guienne was the only province left to him of all the continental possessions left him by his father. In the time of Henry III. attempts were made to recover these possessions; but ultimately all claim to these provinces was waived by Henry, although Limousin, Perigord, and Querci were restored to the English. Guienne was temporarily lost to the English in 1294, but soon restored. Calais was captured in 1347, and several other successes increased English power in France; but at the close of Edward III.'s reign, Calais, Bayonne, and Bordeaux were the only English possessions on the Continent. Henry V.'s successes in France seemed to place the French crown once more within the reach of the English king, but on his death, principally through the instrumentality of Joan of Arc, every place was lost except Calais, and that town was eventually lost in 1558, since which time England has had no possession in France.

SECTION III.

1. *The Tower of London* was built by William the Conqueror; Henry III. fortified himself in the Tower, 1261; Edward V. and his brother the Duke of York were murdered in the Tower, 1483; formerly a royal residence, then used as a State prison; among others confined there were the Princess Elizabeth, Lady Jane Grey, Anne Boleyn, the latter being beheaded within the walls. Sir Walter Raleigh wrote his 'History of the World' during his thirteen years' confinement here.

Holyrood House.—A royal residence till the union of the two kingdoms, and still sometimes used for this purpose. Darnley and Mary, Queen of Scots, were married in its private chapel, 1565; and Rizzio, the Queen's private secretary, was murdered in the Queen's antechamber, 1566. Charles, the young Pretender, 1745, took up his residence in Holyrood.

The Murder of the Princes.—One of the first acts of Richard III. after his coronation was to rid himself of the possibility of the return of Edward V., his nephew, to the throne. The Constable of the Tower, Sir Robert Brackenbury, was commanded to put the young king and his brother to death, but he replied that 'he knew not how to dip his hands in blood.' He had, in consequence of his refusal, to deliver up the keys and custody of the Tower for one night to Sir James Tyrrel, who hired Foster and Deighton to smother the princes during their sleep. The skeletons of two bodies were found underneath the stairs during repairs, and these are supposed to have been the remains of the two princes.

Tudor. *Mary.*—The Queen married Philip, son of the Emperor Charles, and afterwards King of Spain, in 1554.

Elizabeth.—Offers of marriage were made by Philip, but refused. The Spanish Armada was one of the consequences.

Stuart. *James I.* endeavoured to secure a marriage between his eldest son Charles and the Infanta of Spain. Charles visited Spain, but the match was never completed.

Anne.—The War of the Spanish Succession took place in Queen Anne's reign; Gibraltar was taken from Spain by Admiral Rooke and Sir Cloudesley Shovel, and the Earl of Peterborough won several battles on land.

3. *Naseby.*—Battle fought in 1645, in which Charles I. was totally defeated.

Derby.—The Pretender advanced as far as this town in 1745.

Plymouth.—Burned by the French, 1403. French and Spanish fleets appeared off Plymouth, 1779.

Worcester.—Total defeat of Charles II. by Cromwell, August 22nd, 1651.

Canterbury.—Primacy conferred on it in 597; murder of Becket, 1170, and Henry II.'s subsequent penance, 1174; opposition of monks to Stephen Langton's appointment, 1207, the *interdict* afterwards following John's action.

Stirling.—Victory of Wallace over English, 1296; conquest of Scotland completed by Edward I. on taking Stirling in 1304; victory of Scots over English at Bannockburn, near Stirling, 1314.

SECTION IV.

1. *Lollards:* a name given to the followers of John Wycliffe. Richard II., and following reigns.

Roundheads: the name given to the national party by the Cavaliers in the time of Charles I., because they generally wore their hair short.

Regicides: the name given to those who had been concerned in the death of Charles I. Time of Charles II.

Pilgrim Fathers: the Puritans who emigrated to America to escape from the persecution of Laud were so called. A.D. 1620, reign of Charles I.

The Cabal: the ministry of Charles II., composed of Lord Clifford, Earl of Arlington, Duke of Buckingham, Lord Ashley, and Duke of Lauderdale. The initial letters of their names make the word Cabal.

2. Sir Robert Peel was the son of a large cotton manufacturer, and was born at Bury in 1788. He was educated at Harrow and Oxford, where he greatly distinguished himself. In 1809 he was elected Member of Parliamen for Cashel and was soon made an Under-Secretary of State. In 1812 he was made Chief Secretary for Ireland—an office which he resigned in 1818. In 1822 he became Secretary of State for the Home Department. In 1834 he became Prime Minister, but held office for only a few months. He returned to office in 1842, and remained Premier till 1846 His career is chiefly remarkable for the change of opinions which he at different times confessed, on being convinced that the measures he had opposed were for the benefit of his country. He had been educated as a strict Tory, to oppose reform of the currency, Catholic emancipation, and the repeal of the Corn Laws, and yet he belonged to ministries which carried out the whole of these reforms. He was a successful financier, a friend to science, art, and literature, distinguished by a love of truth and justice, and ready to sacrifice personal considerations where the welfare of his country was at stake. His death was caused by a fall from his horse in 1850.

3. The destruction of the French fleet in the *Battle of the Nile* prevented Buonaparte from carrying out his threat of conquering India. It caused his return to France, where by skilful management he overthrew the existing government, and became First Consul. In England the news of the victory roused the national spirit, while throughout Europe hopes were entertained that the power of France would be completely broken. New alliances were formed against her, the Sultan declared war against her, and, by the aid of Sir Sidney Smith, the French were driven completely out of Syria.

The *Battle of Quebec* destroyed the power of France in Canada, and the whole of British America was lost to France in the following year, the Treaty of Paris giving Canada, Nova Scotia, and Cape Breton to England.

Ships were then sailing vessels, built of wood: now they are steam vessels, built of iron and steel. The guns of that period were small, and muzzle-loading: now they are large, and generally breech-loading. Then torpedoes were unknown: now they are a recognized instrument of war; and muskets have given place to rifles.

[The remaining part of the Scholarship Questions will appear in our next issue.]

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Health at School.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),
Vice-President of the British Medical Association.

VIII.—VENTILATION—*continued.*

WARMING AND LIGHTING.

IT will be seen from the foregoing that crowds are manufacturers of foul air, as well as of the draughts which are set up for its removal after its manufacture. Draughts will be best prevented by warming the air, which must and will get into the place which foul air has contaminated, when that contamination is accompanied by a rise of temperature. It is shown that the best way to warm that air is by means of jets of gas so arranged as not themselves to be contaminators of the warmed air. There are many advantage in the use of gas. If judiciously adapted it produces warmth at the same time that it is able to remove the foul air manufactured by the crowd. It obviates the mischief which arises from the concentration of heat in one place, such as happens when heating is effected by open fireplaces. The greatest advantage attending its use is that it can be almost infinitesimally divided. It obviates dirt and dust; coal bunks are not required, there are no smoky chimneys, and, as a consequence, when its use becomes more general for such purposes there will be a considerable diminution of intensity in those dense fogs which now oppress large cities wherever coal is consumed in the wasteful way which is the custom at the present day. The use of gas for lighting purposes will gradually diminish, but its use for heating and ventilation is only commencing, a gas of lower illuminating but greater heating power may be produced at a less cost than that of the gas which is now in use, and when it is available it will be found to be by far the cheapest way of warming all public buildings in places where gas is in general use. Even when 3s. 6d. per 1000 feet has to be paid for it it is cheaper than coal, all things being taken into consideration, that is if the arrangements are carried out in a proper manner. Fortunately the necessities of a period always bring forth the help which is wanted, and this is the case here, for the General Gas Heating and Lighting Apparatus Company, as well as other firms, provides every kind of help which is wanted in connection with warming and ventilation. There are very few places in which gas is not now available, and there ought to be no difficulty in its adaptation, except that which naturally belongs to a first expenditure of capital, in order to get these matters properly arranged. No system of ventilation is satisfactory which allows the temperature of the room to rise above 60° in cold weather, or which does not allow the air to be renewed during the day, very many times over. A school attendance without exposure to draughts of cold moist air must be a necessary part of the performance. I use the term 'cold moist air' because it is the presence of moisture which seriously adds to the evil of draught. Its opposite of dry hot air is similarly hurtful, and must be equally avoided. These conditions having been laid down it is necessary that there should be an intelligent supervision of the means in use, and that the laws which regulate these means should be understood by the attendant who is in charge of the school; otherwise, as the conditions outside are constantly altering, frequently in a direction antagonistic to those within, if the latter are not altered to correspond with those changes there will be failure in the principle adopted, and a resulting evil, for there is no plan of ventilation which will be always self-acting and equal to all changes. I have said that the method of ventilation is intimately associated with that of lighting. The part of my subject connected with light will be dealt with more fully in the section which will be devoted to eyesight, but I may now remark that the direction in which the light falls upon the student's desk or book is of great importance in connection with correct teaching. A combination of lights throw double shadows. The worst light is that which comes directly from the front of the scholar. It is not good for him to sit in a window facing a bright light. The light should come to the scholar from a point on either side, or above the shoulder, or from behind him; that from the left side is best. It is not beneficial to have the light entering from both sides of the room unless it is a very large one. Those lights directly to the rear are bad, because they throw the shadow which is produced by the scholar upon his work. It is necessary also that the light should not be directly in front of the teacher. That position of it positively decreases his power of overlooking the pupils,

and may at the same time be absolutely annoying to himself. It is necessary to arrange the work of the school upon the lines indicated by these suggestions. Abundant light is absolutely necessary, and the more fully it can be arranged so as to strike the desk at a considerable angle the better for the pupils. The higher the windows rise, therefore, in the wall of the room, the better also for lighting as well as for ventilating purposes. Windows that are too low down are not of so much use. The lower panes are of no service for lighting, though they are useful for ventilation when the windows are made to open both top and bottom. A school should have at least one-fifth of its wall space devoted to lighting by the sun's rays, and if it amounts to one-fourth so much the better for both health and education. A so-called dim religious light is opposed to health, and tends to develop the hysterical state so much admired and so much promoted by some schools of religious thought. It cannot assist to bring out a healthy mind, and, as a consequence, it must impede the healthy action of brain matter. Light goes with knowledge and mental power. A dim light probably impedes the formation of the habit of private judgment, and assists the pupil to follow the lead of the teacher more closely; but it does not tend to health. That which does not produce a perfect state of bodily health, or impedes its growth, cannot be good for any body of people, and this applies to children much more than to adults. I object, therefore, upon points connected with Hygiene to a dim religious light. Light must be diffused as equally as possible all through the room: dark corners and dark ends should be got rid of by opening windows in the blank walls, or putting in skylights, if the walls are not outside walls. The direct light from a skylight is not so beneficial as an oblique light. Those schools which are to be used for drawing classes will generally require that the light should come in from above as well as at the sides of the room. The more openings which can be made to communicate with the outer air the better for ventilating as well as for lighting purposes. It will be found that a domed roof is better than a flat roof for both objects, and when skylights are obliged to be flat they must be protected by proper blinds.

It will be right to give a few instructions upon the method of lighting by artificial means for those schoolrooms in which evening classes are held. The time for the use of the electric light in our schools has not quite arrived. The division of the electric light at present is too expensive to allow of its introduction into the school and class-room; but the day is not far distant when the change will be made, to the infinite advantage of the general health of the people. If gas is used for lighting purposes in the way that it is at present, it so completely deteriorates the air of the room as to quickly take out all the healthy vital properties which belong to it. Ozone is rapidly removed, and the oxidizing power of the air very much diminished thereby. That is when gas is used with an ordinary burner. If it be enclosed in glass globes, such as are made by Benham, where the products of combustion are compelled to leave the room at once by a proper conduit, the evil is obviated. The conduit passes from the globe into one of the flues, or directly out of doors into the open air; whilst the gas itself is supplied with air by another tube, which draws its supply from some available source. The evil of gas is also, to some extent, obviated by the ordinary sun-burner, which is fixed a short distance below the roof, with a chimney directly above it to carry off the foul air which results from the combustion of the gas; and with it also a portion of the heat is made to escape. The difficulty which belongs to the sun-burner, viz., its concentration, is overcome if gas is used with closed globes in those parts of the room which the light from a sun-burner does not reach. Pendant stars, freely multiplied at a considerable height, are good means of lighting in lofty schoolrooms, provided ventilation is quite perfect. No method, however, except the electric light, is satisfactory, unless there is an increased power of ventilation, especially as regards the entrance of fresh air, wherever the gas is lighted. Rooms are generally provided with conditions of ventilation which may be satisfactory when the room is moderately filled in a bright cool afternoon; but let it be filled full and the gas lighted when the lights are simply wall burners or standards, and then, in a very short time, the air of the room becomes absolutely pestiferous. It is probable that an immense injury is done to the public by the present method of lighting this class of room in the manner indicated. To remove this great evil all the products of gas combustion must be carried out of doors as quickly as possible without the possibility of their being breathed by the children. It is necessary for all the windows to be fitted with roller blinds, so that the light of the sun may be diminished when necessary, and the direct rays kept from interfering with each other, and producing a cross light. When gas is used in a school during the teaching time, each lamp should be provided with a shade, by means of which the intensity of the light may be broken. The shade should not be so opaque as to cast a shadow upon the upper part of the room; but it should be just enough to allow the light to be looked at without inconvenience. Ground-glass shades are useful for this purpose. These are important points which will be referred to in another part of my subject—viz., eyesight. There is much difficulty from the ordinary sun-burner, so that it is all but inadmissable for teaching purposes in common schools. If used at all, it should have the bright light prevented from falling directly upon the desk of the pupil by properly managed reflectors.

It will be seen that I make no mention of hot water for heating purposes. Hot-water pipes are costly; the apparatus is liable to go wrong at the most unfortunate period, and cannot be easily put right again, whilst there are other dangers attending its use, which make it unwise economy in school houses; and hot-air flues are even worse still. I like the appearance of an open fireplace; we are so accustomed to its presence that a room does not seem to be furnished without one; but I object to the dust which an ordinary fire produces. and, wherever possible, I would advise that the use of coal be discontinued, and some form of gas be used. if gas is reasonable in price—that is, not more than 3s. per 1000 feet. If it is too expensive to be used in this way, or the gas is not available for the purpose as suggested with gas jets and ventilators, then some form of closed stove on the slow combustion principle manufactured of fire clay should be used.

I can confidently refer to Mr. Doulton's slow combustion stoves as admirably fitted to economise fuel, to diffuse warmth, and save trouble, as well as annual

expense in housekeeping. They may be lighted over night in cold weather, and will keep the place warm for the following day, or if lighted early in the morning in more moderate seasons, will warm the room most thoroughly in a few hours, but, being slow burners, they do not get up heat very rapidly, and it would not do to light them only just before the assembling of the school, at least in very cold weather. The quantity of fuel which they consume is, however, so small that it is advisable and not expensive to have them lighted over night in all severe seasons. The temperature of a school-house or class-room should not be allowed to fall below 45° at any time, night or day, whilst the school is in session; if the walls get quite cold, there is a difficulty in warming them again, whilst if the room is well ventilated immediately after the class has separated, and if it is cleaned up at once, as it ought to be, and not left until the morning, in cold seasons, the stove lighted and allowed to burn all night, the room will never get cold at all, if Doulton's stoves are used or two or three of the gas jets kept alight. The walls of the room do not get cold, and the children are comfortable as soon as they enter the room on a cold winter morning, instead, as is too often now the case, shivering and quite unable to take in the teacher's meaning until the warmth from their own bodies has warmed up the place. In the meantime the radiation from the cold walls upon those children who sit near to them may have inflicted very serious injury.

I would urge managers of schools to recollect this, and not allow the walls to get cold. Ventilate the room well immediately after the class is concluded; get rid of all foul air before it has had time to be absorbed by the walls. The epithelial cells and other debris left in the place should be removed before they can be deposited in chinks and crevices, which are sure to be present. Have the floors swept up as soon as the class is over, and then the place dusted. Then close up for the night, lighting the warming apparatus if the thermometer is likely to go down below 39·5; there will then be a healthy room for the children to assemble in in the morning, comfortable to their feelings, assisting them in their work, and making their control and management all the more easy to the teacher and his staff. The first half hour is not then lost by the children in their efforts to get warm and to escape from the depressing effect of cold walls, which abstract warmth from the little scholars, and very often do them a serious injury. There is another part connected with lighting, but often neglected in all classes of schools. The windows are seldom cleaned. This is a duty which should be regularly performed. The deposit of filth from the breath is considerable upon a sheet of cold glass. If it be allowed to remain there and to dry up, it may be a source of mischief; it assists to depreciate the vital properties of the atmosphere, because it adds to the matter to be oxidized. It is not a large addition, but there is enough to propagate infectious disease, if germs of infectious matter should be deposited on the glass. A well-conducted school requires that the windows should be cleaned as regularly as the floors are scrubbed and the walls dusted down. It is a duty that should be placed upon somebody to see that it is done, for it is attention to minor matters which more certainly ensures that greater ones shall not be omitted.

Anecdotal Natural History.

BY REV. J. G. WOOD, M.A., F.L.S.,
Author of 'Homes without Hands,' 'Nature's Teachings,' etc.
AND THEODORE WOOD, M.E.S.,
Joint Author of 'The Field Naturalist's Handbook.'

No. IX.—THE CETACEA, OR WHALES.

THE mere fact that the Whales are exclusively inhabitants of the water, is usually held to be a sufficient proof that they should be included among the fishes. In fact, it is generally considered that all sub-aquatic creatures, be they mammals, fish, crustacea, or radiates, may be included under the one comprehensive title.

As far as the whales are concerned, there is certainly some ground for the idea. Their habits and mode of life, their food, and their very form, so closely resemble those of the fishes that we can scarcely wonder if these animals are popularly supposed to form part of that group. We have only to look a little more closely into their structure, however, to find that they have nothing in common with fishes.

An examination of their mode of breathing is alone sufficient to point out the true position of the whales in the animal kingdom.

It is well known that all the fishes respire by means of gills, by the agency of which the necessary oxygen is extracted from the water which they inhabit. But the whales, like all other mammals, are obliged to breathe atmospheric air by means of lungs, for which purpose they are compelled to rise to the surface of the water. Were they prevented from doing so, they would be drowned just as would any other mammal under similar circumstances. The mode of life of the whales, however, differs completely from that of other mammalia, the breathing apparatus being modified in such a manner as to allow them to remain beneath the water for a considerable space of time. This structure we shall presently examine in greater detail.

As the method of respiration effectually disproves the general notion that whales should be ranked among the fishes, there is little difficulty in placing them in their true position. The structure of the heart, which possesses two auricles and two ventricles, whereas the fishes only possess one of each, and the fact that the young are nurtured by the mother's milk, are proofs amply sufficient to determine their true situation to be among the mammalia.

In few other animals do we find the structure more curiously modified to suit the conditions of existence than is the case with the whales. Passing the whole of their life in the water, their form, like that of the fish, is that best adapted for passing through their native element; the organs of locomotion, however, are of a different nature.

The fore-limbs, until stripped of their covering, closely resemble the fins of a fish. They are, however, of little use in forcing the animal through the water, their chief duty lying in preserving the equilibrium of the body and in clasping their young. The hinder limbs are not developed, being visible merely as small and imperfect bones when the skeleton is examined. In fact, they can scarcely be said to exist at all, and the very pelvis is only a slight rudimentary process, not attached to the spine.

The great organ of locomotion is found in the tail, which is set transversely with the body, and is usually

of very great comparative size. In a whale of ordinary dimensions, the tail, though only a few feet long, would measure in breadth almost one-fourth of the whole length of the body. Even these dimensions, large as they are, are sometimes exceeded; a whale captured a year or two since, and which was only sixty-five feet in length, measured no less than twenty-seven feet in the breadth of the tail.

The muscular power of this organ is simply enormous, the animal being enabled by its aid to leap clear out of the water to a height of several feet, a movement usually known as 'breaching.' The chief danger in whaling lies in the blows of the animal's tail, any one of which is sufficient to dash the boat and its occupants to fragments.

its owner, the animal would inevitably be killed by the shock caused from the first blow of its own tail.

In point of fact, the external ear of the whale is so small that it will scarcely admit a crowquill.

Here we are met by another problem.

Even when the whale lies on the surface the ear is under water, and can only hear sounds that are transmitted through the water. How, then, is the whale to hear sounds that are made above the surface and are transmitted through the air? The difficulty seems insuperable, but is overcome in the simplest manner imaginable. Let us see what is the structure of the ear in mammalia, taking our own as an example.

First, there is an aperture for the admission of air

Right Whale.

Although in almost every pictorial representation of the whale the eye forms a very conspicuous object, it is in reality extremely small in comparison with the size of the animal, sight being of little use in taking the prey. The ear, too, is exceedingly minute, and for a very good reason.

It will be remembered, of course, that water which is much more dense than air, is a proportionately excellent conductor of sound. If a man submerges his head he can hear the beat of oars upon the surface, while the boat to which they belong is a mile or more distant.

Again, if a swimmer dives beneath the water, and a heavy blow be struck upon its surface above him, he not only hears the sound, but is almost stunned by the shock. So we can easily see that if the ear of the whale were proportioned in size to the dimensions of

At a variable depth in this aperture, a very elastic membrane, called the 'tympanum,' or drum, is stretched tightly across it, and is acted upon by any vibrations of air which are rapid and regular enough to become sounds.

On the other side of the drum is a set of bones, called, from their appearance and office, the hammer, anvil, and stirrup. These take the vibrations of the drum, and transmit them to the nerves of hearing, through which they pass to the brain. I may incidentally mention that the modern telephone is nothing but a rude imitation of the structure of the ear.

The tube does not end at the drum, but passes on, though very much reduced in size, to the back of the throat. If this secondary tube (called the Eustachian tube) be stopped, deafness results, because the vibrations of the drum are checked.

Now, in the whale the size of the two tubes is reversed. The external tube is very small, but the Eustachian tube is very large, and passes into the nostrils, or 'blow-hole.' The aperture of this blow-hole is always above water when the whale floats on the surface, so that the vibrations of the air can pass through it to the tympanum. Thus the whale hears through the blow-hole any sounds which are caused by the vibration of air, and through the external tube those sounds which are caused by the vibration of water.

I mentioned that the blow-hole has only a partial right to the name of nostril. It performs only one duty of a nostril, *i.e.*, that of admitting air to the lungs, and is not in any way an organ of scent. In fact, the sense of smell is absolutely wanting in the whale tribe, the entire system of olfactory nerves being absent.

No water can pass down the blow-hole, a simple and very effective valve being so arranged that it closes the aperture by the mere pressure of the water above it.

The whales being warm-blooded animals, some provision must necessarily be made for retaining the vital heat of their bodies in the conditions under which their lives are passed. Yet to all outward appearance, this seems to have been entirely neglected, the smooth and polished skin being apparently the very worst medium which could possibly have been chosen.

A glance beneath the surface, however, tells a different tale. We find that immediately beneath the skin is a layer of coils of fat, some twelve to eighteen or more inches in thickness, which is enclosed in tough, membranous cells. This substance, commonly known as 'blubber,' serves a double purpose, the non-conducting fat retaining the heat of the body, while the thick elastic mass resists the enormous pressure of the water at the vast depths to which the animal descends.

We now come to the remarkable modification of the breathing apparatus which allows the whale to remain beneath the water for a considerable space of time without rising to the surface in order to obtain a fresh supply of air.

As is the case with all warm-blooded animals, respiration in some form or other must be continually kept up. The blood must be constantly supplied with oxygen or life cannot be preserved.

With the whale, however, the necessity for constant respiration would entirely prevent it from pursuing its search for prey at the depths to which it descends, and would oblige it to face death in one of two forms —starvation or suffocation.

A most wonderful structure is therefore provided, which enables the animal to aërate a supplementary stock of blood, which can be introduced into the circulatory system as occasion requires, taking the place of the exhausted fluid, and doing away with the necessity for constant respiration. This is managed as follows :—

When the whale ascends to the surface of the water in order to breathe, it makes a succession of inhalations, generally some forty or fifty in number, which are usually termed the spoutings, on account of the shower of water mixed with hot breath, which is thrown up into the air to the height of eighteen or twenty feet. During this operation, the whole of the blood is

thoroughly ærated, not only that in the circulatory system, but also the reserve supply, which is stored away in a vast mass of auxiliary blood-vessels which line the interior of the chest. These vessels contain a sufficient stock of the purified blood to sustain the animal for a considerable time without obtaining a fresh supply of air, and it is by no means unusual for a whale to disappear beneath the water for upwards of half-an-hour without rising to replenish its stock.

Were it not for the knowledge of this habit the difficulties of whaling would be greatly increased; as it is, however, the huge animal is slain with comparatively little trouble.

When a whale is seen, a boat puts off and makes for the spot as speedily as possible.

As soon as the boat approaches within a short distance, a harpoon—a spear with a barbed head, to the end of which is attached a coil of rope—is flung at the animal.

The frightened whale instantly dives beneath the surface, carrying the harpoon with it, the rope being uncoiled from the boat as rapidly as possible. For half an hour or so, the animal remains beneath the surface, but is at length obliged to rise in order to procure a fresh supply of air. No sooner does it appear, and begin its spouting, than the boat approaches, and again drives it below before the operation is completed.

Not having been able to aërate the whole of the blood, it cannot remain so long beneath the surface, and is soon obliged to again rise in search of air. Again it is driven below, and so on until the animal is so weakened from want of air that the pursuers can come to close quarters.

The depth to which a whale will descend when pursued is simply astonishing. On one occasion the animal took down with it more than one thousand fathoms of rope, or considerably over a mile, and yet was enabled to bear the tremendous weight of the rope, and also to drag the boat with its pursuers rapidly through the water.

It appears strange that so comparatively insignificant a weapon as the harpoon should prove so deadly to an animal of such enormous dimensions. But the animal does not lose its life on account of the very slight wound produced by the harpoon.

The real instrument of death is the spear, which has a small and very sharp blade and a very long handle. When the whale is quite exhausted by fatigue, the spear is thrust into the vital organs, and in spite of its size the animal easily succumbs.

Formerly, the harpoon was always thrown by hand. It is now mostly shot from a gun, and, of course, can penetrate more deeply than the hand-thrown weapon.

To mankind, whether in a civilized or a savage condition, the whale is of inestimable value. From the blubber and other parts of the body we obtain the valuable oil, which in many countries is almost a necessity of life; the so-called 'whalebone,' and the bones themselves are of considerable value; and, by the dwellers of the polar regions, almost every part of the body is used as food, the skin, and, more particularly, certain parts of the gums, being considered as very great dainties.

The curious substance popularly known as 'whalebone' deserves a few words.

To the title of 'bone' it has no claims whatever, its structure being analogous to that of hair, feathers, scales, and teeth, which are merely the same substance under different forms. It is found in the jaws, lying in thin flat plates of various breadth, and from ten to twelve feet in length. These do not spring from the gums themselves, but from a curious vascular formation resting upon them. Each plate is split at the extremity into a number of hair-like filaments.

In a certain sense, the whalebone takes the place of the teeth, inasmuch as it captures the prey, although it is not used for mastication, which, from the nature of the food, is rendered unnecessary. Its use is as follows.

Those species of whales which are provided with the 'baleen,' or whalebone, prey upon creatures of very minute size, such as small shrimps, crabs, and lobsters, medusæ, etc., which are generally found in large shoals. Its chief food consists of a small mollusc called the Clio. Opening its huge jaws to the widest extent, the whale drives rapidly through the shoal, thus filling the mouth with the little creatures; the jaws are then closed, and the contained water is driven out through the interstices of the whalebone. This, however, completely prevents the escape of the prey, which can then be swallowed at leisure.

Having now glanced at the principal characteristics of the whales as a family, we will take each of the more important members in turn, and devote a short space to their habits and peculiarities.

The first in order is the Greenland Whale (*Balæna mysticetus*), or, as it is often termed, the Right Whale. This whale is an inhabitant of the seas bordering upon the northern polar regions, where, in spite of the annual slaughter, it is still to be found in considerable numbers.

The Greenland whale, although of great size, is by no means equal to the huge rorqual in its dimensions. Its average length is from fifty-five to sixty feet. The head is extremely large, occupying rather more than one-third of the whole bulk.

The colour of this whale is a deep velvety black upon the upper parts of the body, and greyish white upon the under surface. It is one of the most useful of all the whales to mankind, the baleen, or whalebone, being long and of fine quality, and the oil rich, and found in great quantity. Even the very bones teem with the oil, the jawbones especially producing a considerable amount.

It is believed that one cub only is produced at a birth in the case of the Greenland whale. For the first few month of its life the baleen is not developed, and the young whale is obliged to depend for the whole of its nourishment upon its mother, who never leaves it until it is old enough to forage for itself.

The Rorqual (*Physalus boops*) is the largest of the whale tribe, sometimes attaining to the extraordinary length of one hundred feet, or even more. In spite of its huge size, it is of comparatively little value, the oil obtained from the body being very scanty, and the whalebone short and of very inferior quality. The animal is therefore seldom molested except by inexperienced sailors who are unable to distinguish it from the Greenland species.

The food of the rorqual consists not only of the minute creatures before mentioned, but also of the larger fish, such as the cod, etc. The nature of the food being so different, the gullet of this whale is of much greater size than in the Greenland whale, in which animal it barely exceeds two inches in diameter. There is a popular saying among seamen that the

Greenland whale can swim a jolly-boat and crew in its mouth, and yet be choked with a herring.

In search of its prey, the rorqual often follows the shoals of fish from place to place, and occasionally takes up its quarters upon the borders of the fisheries, to which it causes considerable damage. In such a case it often happens that, pursuing its wished-for prey rather too rashly, it becomes stranded upon the beach, where it is utterly helpless, and is easily slain. A year seldom passes, even in our own country, without a rorqual or two being stranded upon the shores.

The rorqual may be distinguished from the Greenland whale by its dark-greyish hue, by its more slender form, and by the fact of its possessing a dorsal fin. The skin lies in deep longitudinal folds along the under parts of the body, for which reason the name 'rorqual' was given to it, that title being derived from a Norwegian word signifying a 'whale with folds.'

The Spermaceti Whale (*Catodon macrocephalus*), or Cachalot, is of great value to mankind, both on account of the oil procured from the blubber, which is of a very fine quality, and also of the substance known as spermaceti, which is found in considerable quantities.

This whale differs in several important points from the two preceding species.

The head is extremely large, occupying nearly a third of the entire length, whence the name *macrocephalus—i.e.*, 'large-headed'—is derived. The snout is abruptly squared off, and the blow-hole is placed upon the fore part of the head. The jaws are not provided with the baleen, or whalebone, but are furnished instead with a number of formidable teeth, set in the lower jaw, and fitting into corresponding cavities in the upper one. The upper jaw has merely a short row upon each side.

Although to us these teeth are of no particular value, they are held in the greatest esteem by certain savage tribes. On more than one occasion a war has been waged by one chief upon another, merely for the possession of a single whale's tooth.

The cachalot attains to a considerable size, its average length being from seventy to seventy-five feet in length.

The skull, which is elongated and narrow, does not occupy more than one-half of the space assigned to the head, the upper portion being composed of tendinous cells. In two great cavities in this mass is contained the spermaceti, which is found in a fluid, oily condition, and is literally baled out by means of buckets, a hole being cut in the upper part of the head, and the spermaceti extracted just as is water from a well.

The oil expressed from the blubber is of a very fine quality, and is obtained in considerable quantities, a cachalot of ordinary size yielding about one hundred barrels, as well as twenty-four barrels, or thereabouts, of the spermaceti.

This whale is able to remain beneath the water for a much longer period than the previously described species, an hour sometimes elapsing before it is obliged to return to the surface. The 'spoutings' are from sixty to seventy in number, and occupy about ten minutes. It is a curious fact that the number of spoutings is always exactly the same in the same individual.

As regards the locality in which it is found the cachalot is a rather ubiquitous creature, inhabiting all parts of the ocean, excepting those in the neighbourhood of the polar regions. It is an occasional visitor to our shores, but is less often seen there than is the case with the Greenland species.

(*To be continued.*)

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Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

Joint Author of 'The Field Naturalist's Handbook.'

No. VII.—THE DERMAPTERA, OR EARWIGS, AND THE ORTHOPTERA.

Part I.

UNTIL of late years, the true situation of the earwigs in the insect world was a matter of considerable doubt. Some entomologists considered that they should be ranked among the beetles; others that they formed a part of the *Orthoptera* (or Cockroaches, etc.) while others again held them to belong to a separate order, which they entitled *Dermaptera*, a word signifying 'skin-winged,' and which was applied to them on account of the peculiar structure of the elytra.

The first of these theories, viz., that the earwigs constituted one of the families of the *coleoptera*, was easily disproved as soon as the life-history of these insects was enquired into; for it was found that the pupæ, instead of passing through that stage of their development in a state of quiescence, as is the case with the beetles, were fully as active as the perfect insects, differing only in the undeveloped state of the wings. Among various other distinctions, also, the formation of the elytra held a prominent place, those organs being in the earwigs soft and leathery, crossing each other slightly at the tips, and not entirely covering the wings, while in the beetles they are hard and horny, and parallel for the whole of their length, the wings, also, being entirely concealed.

From the *Orthoptera*, which in other points they closely resemble, they differ in the manner in which the wings are folded, those of the cockroach, cricket, etc., lying in longitudinal folds alone, while in the earwigs they are folded transversely, as is the case with the beetles. The elytra, too, of the *Orthoptera* are strongly veined.

These points of difference being taken into consideration, it was determined that the earwigs constituted a separate order, and the title *Dermaptera* was for a long time applied to them. Some confusion, however, arising as to the insects comprised in the group, many entomologists including the cockroaches and others among the *Dermaptera*, the word *Euplexoptera*, or 'beautifully-folded wings,' was suggested by Professor Westwood for the earwigs, and this arrangement is now almost universally recognised.

Concerning the popular name, too, a great deal of misconception has arisen. More especially among the lower classes, the earwig is held in considerable dread, owing to its reputed aptitude for entering the human ear, and penetrating by some remarkable channel to the brain, which organ is supposed to be so affected by the presence of the insect that madness immediately follows. It is, of course, unnecessary to point out the impossibility of such a proceeding on

the part of the earwig, no passage existing between the brain and the external ear, and the entrance of the insect for more than a very short distance being completely out of the question.

A more probable derivation of the popular title is from the two words 'ear' and 'wing,' *i.e.*, 'earwing,' the form of the wing of the earwig being almost exactly that of the human ear.

There must be few who are not practically acquainted in some degree with the common earwig. In many ways the insect is objectionable enough, its destructive habits, among fruit and flowers especially, causing it to be regarded with almost universal disfavour. Yet the earwig, like every other insect, is worthy of the most detailed study and examination, and the more time we devote to its structure and habits, the more points of interest do we discover.

The most superficial observer can scarcely fail to notice the remarkable structure placed at the extremity of the body, which closely resembles a pair of curved forceps. The popular idea, leaping at once to the conclusion that everything connected with the insect must of necessity be prejudicial to mankind, holds that these forceps are created for the express purpose of nipping human fingers. As barely one earwig in ten thousand ever comes into contact with a human being, it is scarcely likely that such weapons would be furnished to the insects against a foe they were so little likely to meet, and the theory is therefore hardly tenable. Their real object we shall presently see.

The elytra, as before stated, are of a soft and leathery nature, therein differing considerably from the hard and horny wing cases of the beetles. In appearance, they somewhat resemble the corresponding organs of the *staphylinidæ* (which, it will be remembered, form one of the principal groups of the coleoptera), being very small in proportion to the size of the wings which they protect, and leaving several segments of the abdomen entirely uncovered.

The wings themselves are most wonderful and beautiful objects, although few have an opportunity of seeing them when thoroughly extended. And for this reason, that the membrane of which they are composed is of so delicate a nature, and the innumerable folds are so difficult to expand, that it is almost impossible to spread them without completely tearing them to fragments, and the still more difficult task of re-folding them and packing them away beneath their cases has probably never yet been performed by man.

How, then, does the insect contrive to perform these operations, neither of which occupies more than a second or two from first to last?

It will be remembered that the *staphylinidæ*, as mentioned in one of the previous papers of this series, are accustomed to fold their wings by the assistance of the extremity of the body, which is bent over the back for that purpose. The same is the case with the earwig, which is enabled to fold its infinitely more complex wings by the assistance of the tail forceps.

The rapidity with which the operation is completed is perfectly marvellous. The insect alights, gives the wings a rapid shake, which has the result of throwing them into longitudinal folds, turns the body over the back, and daintily folds them up with the forceps; it then pushes them beneath the elytra, which it finally smooths over them, the whole operation consuming barely two or three seconds.

In order to facilitate the folding of the wings, these organs are formed of a number of strong nervures, running longitudinally, between which is spread the membrane of which the wings are composed. These ribs, or nervures, are furnished with a double set of leathery hinges, so that they can be folded back upon themselves in somewhat the same manner as the cover of a book.

The life-history of the earwig, at least as regards one point, is probably unique in the insect world.

It is a well-known fact that insects, as a general rule, never see their own offspring; far less do they tend them and bring them up. The object of their existence seems to terminate as soon as the eggs are deposited, the parent insect seldom surviving that operation for more than a few hours. In very few cases is she still living when the eggs are hatched, the larvæ being able from the moment of their birth to take care of themselves.

Some insects, such as the bees and ants, are perfectly helpless while in their larval condition, and are therefore nurtured and tended by perfect insects. But not by the parents, although they may still be living, their object in life seeming to be entirely confined to the deposition of eggs.

The earwig, however, furnishes a remarkable exception to this rule, for the maternal parent not only continues to exist after her eggs are deposited, but actually watches over and guards her progeny from danger. It is by no means unusual, in the early spring, on turning over a stone or log, to see the parent earwig sitting over and guarding her eggs, or, a week or two later, her young brood. I have myself found as many as five or six batches of eggs, each guarded by the mother, in the course of a single day.

The parent insect may be repeatedly removed from her post, but will as often make her way back to the spot, giving even her very life in behalf of her offspring.

The eggs are usually placed by the parent earwig in some moist and damp spot, and are shifted to another situation if the locality should show signs of becoming too dry for their welfare.

Both the larvæ and pupæ of the earwig closely resemble the imago, and by a casual observer would probably be considered as adult insects. The larvæ, however, are without traces of wings, and the pupæ only possess those organs in a rudimentary form, while the tail forceps are without the strong curve found in those of the perfect insect. The antennæ, too, are formed of fewer joints.

Several species of earwigs inhabit Great Britain, all of them, with a single exception, being tolerably common. Most of them, however, are so similar in habits and appearance to the common species (*Forficula auricularia*) that a separate description is unnecessary, and we therefore pass to the solitary rarity in the group, namely, the Giant Earwig (*Labidura gigantea*).

As its name implies, this insect is far superior in size to the commoner species. It is an inhabitant of the sea-coast, dwelling among the rocks during the day time, and venturing out at night in search of prey.

The forceps of the insect, which are very long in proportion to the size of the body, are of a rather remarkable form, being almost straight, without the decided curve found in those of our common species. In the female, these organs are comparatively small.

Among the foreign earwigs, also, there is, curiously enough, both in form or habits, but little variety to

what we might expect when we take into consideration the strange developments of structure found in insects of other orders. One species is, however, remarkable for the enormous size of the forceps, which, at any rate in the male insect, fully equal the entire length of the body.

We now come to the *Orthoptera*, or 'straight winged' insects, so called because the wings can be folded longitudinally only, and not transversely, as can those of the beetles and earwigs. The order comprises the insects popularly known as Cockroaches, Grasshoppers, Crickets, Locusts, etc.

Among the other distinguishing characteristics of the insect of this order may be mentioned the construction of the elytra, which are tough, leathery, and strongly veined, and the formation of the mouth, which is furnished with jaws suitable for cutting the substances which are selected as food. This formation of the jaws effectually distinguishes the *Orthoptera* from the *Heteroptera*, which otherwise they closely resemble, and which are provided with a beak, or proboscis, through which fluids can be sucked into the mouth.

The *Orthoptera* are usually considered as being divided into four groups, the first of which, viz., the *Cursoria*, or 'runners,' comprises the rather unpleasant insects bearing the popular title of Cockroaches.

Male and Female Cockroaches.

Our common British cockroach must be familiar to all, for, although it is not an indigenous inhabitant of Great Britain, there is now hardly a part of the country in which it is not to be found in abundance.

The insect is perhaps more commonly known by the erroneous appellation of 'black-beetle,' a very mistaken title, the insect being neither black nor yet a beetle.

There are few creatures more thoroughly detested than the cockroach, and certainly not without some reason, for it cannot be denied that it is both mischievous and destructive, as well as being possessed of a most unpleasant odour. Yet these disadvantages are fully counterbalanced by the benefits which it confers upon us, and to which we shall shortly have occasion to refer.

There are comparatively few houses which are not infested by these insects. During the day time they keep carefully out of sight, knowing instinctively the danger of making their appearance. As soon, however, as the house is closed for the night, they emerge from their retreats, and proceed to forage in search of food. If a light be suddenly brought into a room, the kitchen more especially, during the hours of darkness, a strange spectacle presents itself. The floor and walls are almost black with cockroaches of all sizes, scampering with all possible speed to their holes, or shrinking in the corners in hopes of avoiding observation.

Among these cockroaches will be found four distinct forms, viz., the larva, the pupa, the perfect male, and the perfect female.

The larva and pupa, as is the case with all the *orthoptera*, closely resemble the perfect insect, the chief point of difference lying in the absence of wings.

The two sexes of the adult insect differ very considerably in appearance. The male, which is by far the more handsome, may be easily distinguished by the superior length of his antennæ, and by the possession of wings, which, in the female, are present only in a rudimentary form; in general appearance, too, he is slighter and more graceful. The head, in both sexes, is only partly visible, being almost entirely concealed beneath the broad and shield-like thorax. The colour of the insects is a rich brownish red.

It is, at first sight, somewhat difficult to understand how the cockroach should have contrived to spread itself so completely over the country. In the first place, of course, it must have been imported by means of ships from the countries of which it was a native. But, so are many other insects, which, although common enough in the neighbourhood of the docks, are seldom or never found at any distance from those localities.

With the cockroach, however, it is a different matter. The insect is by nature a lover of warmth, and is therefore greatly attracted by the heat of the kitchens of the neighbouring houses. Once ha ing taken up its quarters, it is easily transferred from house to house in numberless ways, chief among which may be mentioned the laundress' baskets, and the bundles of firewood from the grocers' shops. Hampers, etc., sent by rail, are tolerably certain to harbour a number of the insects, so that their talent for spreading themselves over the country is easily explained.

Once fairly within a house, it is an almost impossible task to thoroughly exterminate them. Insect powders may be employed with apparently the best results. Every morning the floors are found to be strewed with the dead and dying in all stages of development. Jars of treacle or stale beer are placed in the corners of the room, and are found almost choked up with corpses in the morning. Daily their numbers diminish, and in a week or two the house is supposed to be cleared of the pests, and the campaign is relaxed.

A month afterwards the insects are as numerous as ever. Yet the baskets and firewood have been carefully examined, and the greatest precautions taken against introducing even a single specimen into the house. Whence, then, have these myriads appeared?

The matter is easily explained. The insect powders did their duty well enough, and destroyed every living insect. But they could not damage the eggs which

had been already deposited, and which, of course, escaped without the slightest injury.

The manner in which the eggs of the cockroach are laid is most singular. Unlike those of other insects, they are enclosed in a tough, horny case, shaped somewhat like an oval purse, with a serrated ridge running along one side, and corresponding to the clasp.

Male Cockroach with wings spread.

Each of these cases contains sixteen eggs, each in a separate cell, and placed in two longitudinal rows, lying in much the same manner as do peas in a pod. When the time approaches for the eggs to hatch, the case opens at the clasp, so to speak, and the young larvæ emerge, their late habitation again closing and seeming to all appearance entirely unchanged.

How these curious egg-cases, which are rather more than two-fifths of an inch in length, are produced has not yet been discovered.

We must not conclude without a few words concerning the services rendered to mankind by the cockroaches.

In the first place, these insects perform the important duties of scavengers. Every piece of wasted food, every scrap upon the floor serve them for provisions, and material is thus removed which, if allowed to remain and putrefy, would probably be productive of serious consequences.

In the next place, cockroaches, although unpleasant enough in their way, are the greatest foes of other and still more disagreeable insects, devouring them with the greatest eagerness, and never allowing one to remain alive in the house in which they have taken up their quarters. So much is this the case, that cockroaches are actually welcomed on board ship, the sailors knowing that they will shortly free the vessel from the insect pests which had before been so troublesome.

Although the common cockroach is not a native of Great Britain, there are other species of the same genus (*Blatta*) which are indigenous to our islands. One of these is a cockroach without a popular name, but which is scientifically known as *Blatta ericetorum*. This is quite a small insect, being scarcely one-third of an inch in length, and of a pale yellow colour. As its name implies, it is found among heath.

Another of the outdoor species is the Field Cockroach (*B. germanica*), a doubtful British native. The egg-case of this insect has the peculiarity of containing no less than thirty eggs.

The Cockroaches were formerly supposed by many entomologists to constitute a distinct order, which they termed *Dictyotoptera*, a word signifying 'reticulated-winged,' and which was applied to them on account of the curiously veined elytra.

(To be continued.)

'How I Teach Elementary Science.'

FOURTH SCHEDULE SUBJECTS: MECHANICS.

BY RICHARD BALCHIN.

ENOUGH has now been said of the 1st stage to show how the whole of this division of the subject is treated. I now pass on to stage 2. Speaking generally, the whole subject is thus arranged:—

1st Stage—'Matter; its states and properties.'
2nd " 'Matter acted upon by force.'
3rd " 'Force accomplishing work.'

The code of 1881 gives the following syllabus:—

1, Matter in motion; 2, The weight of a body, its inertia and momentum; 3, Measures of force; 4, Work done by a force; 5, Meaning of the term energy; 6, Energy cannot be destroyed; 7, Modern notions as to heat.

In this scheme, I would change the wording of the 6th item, and say 'Neither force nor matter can be destroyed or created;' and in the 5th item include, 'the meaning of conservation of energy.' My reasons for doing so will appear by-and-bye. In the second stage, as in the first, I have prepared a detailed syllabus of lessons for the year. It is as follows:—

1. Motion of matter; definition of motion and velocity; motion the law of the universe; absolute and relative motion and rest: uniform, accelerated, and retarded velocities.
2. Force, the producer of motion; definition, measure of force and of velocity; momentum and inertia.
3. Newton's laws of motion; parallelogram of motion and of forces.
4. Work; definition; distinction between force and work; unit of work; measure of work; horse power of steam engine.
5. Energy; definition; potential and actual energy; conservation of energy; distinction between force, energy, and work.
6. Heat, a force; mechanical equivalent of heat; old and modern notions respecting heat.
7. Natural forces; all force naturally existent, force of gravitation; chemical force; electrical force; heat force; change from one kind of force to another; indestructibility of force as of matter; uncreatability of force as of matter; purpose of machinery, to connect a force with the work to be done, and to direct such force.
8. Gravity and weight; definition of gravity and of weight; meaning of the statement 'gravity varies inversely as the square of the distance;' same law as applied to light and heat.

I have no hesitation in saying that this is the most magnificent series of subjects for the exercise of the powers of the educator that can well be arranged. If a boy, under the influence of a philosophical teacher, has two intellectual drills per week on the above plan, he will, by the end of the year, have received such an accession of mental power as shall fit him, in after life, to think for himself, and think correctly; to act for himself and for others, worthily; and, in short, to take his place in the ranks of the thoughtful citizens of his country. And this is the character we teachers should lay ourselves out to form. Of course, if there are some among us who never think for one moment

of forming character at all, but only of making percentages and getting grants, to such it signifies but little what series of subjects or what schemes they adopt. They are mere creatures of Robert Lowe, and not educators at all. These are happily, however, the minority. Most of us have seen the gradual growth of intellectual power, under the influence of our teaching. Most of us have had experiences similar to the one I passed through a few evenings ago. It was this. I am a vice-president of a large Liberal club. A gentleman on the committee made a lucid and powerful speech at an important general meeting. He was one of my old British-school boys. Now he is the father of a family and one of the most respected and influential men in his neighbourhood. As I sat and listened to him I distinctly recognised the mental moulding he had received when a boy at the old school—a school where there was little of code, but much of soul. I have my reward. I ask, Is it not this 'mind-shaping' that produces Garfields? And how many 'Garfields' are likely to come from our schools? I am told that this Mechanics is a 'dry' subject! Is it? Only a few days ago I was giving a lesson on the conservation of energy. Warming with the subject, I described a mountain torrent suddenly dammed up by a great fall of earth across its path. Pictured the vast accumulation of pent-up waters. Spoke of the tremendous potential energy there generated; of the threatening trembling of the barrier, the fearful crack, the fall, the rushing of the waters, and their dreadfully destructive energy now all actual. Eighty little eyes flashed from the desks with the fires of excitement; scarce one of the boys but what had risen from his seat, blazing all up with ardour, and wanting to ask questions about it. A dull subject! Let none but the 'Dry-as-dusts' say so. And I cannot but feel that in a school which is not a mere valley of dry bones without a soul, this subject may be the means of generating such an amount of potential mental energy, that the boys possessing it, and making it actual in their after lives, shall have reason to bless the force of soul of the teacher that originated it.

There is, perhaps, one disadvantage about this second stage. It is not capable of being illustrated by so many experiments of a striking character, as are the first and third stages; nor will any mechanical contrivance, or apparatus, that the boys so delight in, be needed. But on the other hand, all the phenomena of everyday life, and all the natural objects around us can be put into requisition. It is essentially a mind-expanding and thought-generating subject. One thing however is needful. The teacher must himself thoroughly grasp the questions involved. It is a most remarkable thing, true nevertheless, that there are some head and assistant teachers who have three, four, and even more 'science certificates,' who are yet unable to explain and illustrate some of the simplest phenomena of everyday life. I know of at least one man who holds thirteen science certificates. Just take a long breath, and imagine a single finite mind with 'advanced' knowledge upon thirteen different sciences! And yet such a one at a loss to explain before boys the striking of a match and the lighting of a tallow candle! I am afraid these 'advanced scientists' have become acquainted with the terms in which scientific facts are expressed, rather than with the ideas underlying those terms. As the Education department seems determined to enter upon a new path, and encourage real mental culture, why not insist that the first science certificate granted shall be for 'Natural Philosophy'? And on the examination paper let at least half the questions set relate to the method of teaching the subject. And grant no certificate at all until the candidate has really given a satisfactory lesson to a class of children or young men, on the particular subject he desires to pass in. For why give a certificate, enabling a person to teach a certain science, before you have ascertained whether or not he can teach at all? If graduates from universities are going to become assistants in our schools simply on the strength of having given some evidence of the possession of, it may be, a crude stock of undigested book knowledge, then 'the Lord deliver me from Sir Harry Vane.' For if such a one be as much my social superior as Lord Randolph Churchill himself, he would still be not worth his salt. Superior social position! This is surely the seasoning in Sam Weller's pies that was supposed to make up for the absence of good meat.

In next month's issue I propose giving an outline of a lesson on 'Motion of Matter.'

'How I Teach Arithmetic.'

(*Continued from page* 377.)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

Another example:—If 16 men in 6 days of 10 hours each build a wall 480 yards long and 8 feet high, what length of wall 12 feet high could 20 men build in 5 days of 12 hours each? Here we see first that the answer requires to be in length of wall, hence the 480 yards is placed above the line to the extreme left. We now take the various (4) ratios as they come in the question, so as to be careful that we omit none. As 16 men built the 480 yards, 20 men can build more, hence the 24 is placed above the line as the numerator or multiplier, and the 16 below the line as the denominator or divisor. In considering the days, we conclude that less wall will be built in 5 days than was done in the 6 days, hence the 5 will be above the line and the 6 below it. Next, as the hours a day in the consequent (12) are greater than those in the antecedent (10), a longer wall will, on that account, be built, hence the 12 above and the 10 below the line. Lastly, as the required wall is to be 12 feet high, against the given one being 8 feet, it is evident that, being a higher wall, a shorter length of it would be built—$\frac{8}{12}$ of it. Hence the arrangement and work will be as follows:—

yards m. d. hr. ft.

$$\frac{30\,\cancel{480} \times \cancel{20}\,2 \times 5 \times \cancel{12} \times \cancel{8}\,4}{\cancel{16} \times \cancel{6}\,3 \times \cancel{10} \times \cancel{12}} = \frac{1200}{3} = 400 \text{ yds. Ans.}$$

Here we notice, as was observed in working Compound Fractions and Multiplication of Fractions, that immense labour is saved by cancelling the numbers as above. Often the *whole* of the lower numbers will vanish, as in the above, since the 3 would go into the 30; but second, or compound cancelling, is difficult to follow, except to the person who has performed it, and is somewhat difficult to show clearly on paper. The above work can be simplified, as in the previous question, by putting the lowest ratios only:—

$$\begin{array}{c}\text{yards} \quad \text{m.} \quad \text{d.} \quad \text{hr.} \quad \text{ft.}\\ \dfrac{\overset{40}{\cancel{480}} \times 5 \times \cancel{5} \times \cancel{6} \times 2}{\cancel{4} \times \cancel{6} \times \cancel{5} \times \cancel{3}} = 400 \text{ yards. Ans.}\end{array}$$

Here the 5 and 6 above the line cancel the 6 and 5 below the line, and the 4×3 (12) below the line goes 40 times into the 480, hence the result.

The most common error into which a boy falls in arranging or 'stating' a question, is that he loses sight of what the answer requires to be in, hence the importance of having the number first put down distinctly headed, as in the above, 'yards,' length of wall. For instance, in the above question, a boy takes the two terms, 16 men and 20 men, and reasons thus:—'20 men will do it in fewer days,' or 'they will require shorter days,' forgetting that the answer required is not the number of days, or the length of the days, but length of wall. Impress well that the eye and mind must be well concentrated on the antecedent—the number first put down—whose consequent is required. In working such sums on the board, I often test the scholars' comprehension by myself presenting the question to them falsely, as above explained, but boys of ordinary capacity easily detect the fallacy. In working Compound Proportion, the number done on the board is very large, as I find that the slower intellects here especially require 'line upon line,' in order to state correctly a question that contains many terms.

We will now work out four questions in Compound Proportion and comment where thought necessary. The first three are taken from my own exercises in 'Reduction and Proportion,' and the fourth from the recent Queen's Scholarship Examination,—July, 1881.

(1) If 150 yards of a trench, which is to be 800 yards long, be dug by 8 men in 5 days, in how many days would 10 men complete the remainder? (No. 47.)

Here $800 - 150 = 650$ yards to be completed. This step, to a feeble thinker or rote worker, is the most puzzling, as he expects, somewhat naturally, that all the terms are expressed in working order. Now state as below, putting the ratios in their simplest form,—

$$\begin{array}{c}\text{days yds. m.}\\ \dfrac{\cancel{5} \times 13 \times 4}{3 \quad \cancel{5}} = \frac{52}{3} = 17\tfrac{1}{3} \text{ days. Ans.}\end{array}$$

In the yards, instead of $\frac{650}{150}$, each number is divided by 13, and in the men the $\frac{8}{10}$ is divided by 2.

(2) If £380 in $2\frac{1}{2}$ years gain £45 interest, what is the rate per cent. per annum—that is, the interest of £100 for 1 year? (No. 84.) Here we will put down the terms in full, giving the time in *half*-years (5 and 2) and then cancel.

$$\begin{array}{c}\text{£} \qquad \text{£} \quad \text{yr}\\ \dfrac{\overset{9}{\cancel{45}} \times 5 \; \cancel{100} \times 2}{\overset{19}{\cancel{380}} \times \cancel{5}} = \frac{90}{19} = \text{£}4\tfrac{14}{19}. \text{ Ans.}\end{array}$$

In considering what the answer requires to be in—money—we observe that we have three expressions of money, but that our answer requires to be in interest money, not principal, which is money out at and producing interest, and will be further explained under Percentages.

(3) A tunnel 800 yards long was undertaken to be excavated in 36 days, but at the end of 30 days it was found that 80 men had only completed 600 yards. How many additional men must be employed to finish it in the remaining 6 days? (No. 38.) This is another puzzling question to boys who work by rote rather than by reason, who as I sometimes remark, use their pencil more liberally than their brain. We have three preliminaries to consider before we can formally state the question:—first, the remnant of the tunnel, which must evidently $(800 - 600)$ be 200 yards; second, the number of *additional* men. This latter is a sore puzzle to most boys, but if we find how many men the work will really take, we can see how many that is above the number previously employed, and consequently must give the number of additional men. Thirdly, the number of days (36) a boy is puzzled what to do with, not seeing that it does not enter into the working of the question at all, as we have the ratio for the days in the 30 and 6 which make up the 36. I now cause the class to read the question in its prepared and amended form,—If 600 yards be excavated in 30 days by 80 men, how many men can do 200 yards in 6 days?

$$\begin{array}{c}\text{men yds. d.}\\ \dfrac{80 \times 1 \quad 5}{3 \times 1} = \frac{400}{3} = 133\tfrac{1}{3} \text{ men,}\end{array}$$

hence $133\frac{1}{3} - 80 = 53\frac{1}{3}$ additional men. Ans.

As $\frac{1}{3}$ of a man is an anomalous expression, it might be viewed as a man for a third of the time—that is, for 2 days out of the 6. In the statement we only put down the lowest ratios, 1 to 3 instead of 200 to 600, as the 200 yards would take less doing than the 600; and 5 to 1 instead of 30 to 6, as the shorter time (5 days) would require more men than the 30 days required. Impress well that when arranging a pair of terms we consider *them* only for the moment as if there were no other terms, the others being left for their own separate consideration.

(4) How many hours a day must 16 Englishmen and 72 Frenchmen work for 34 days to do a piece of work that 24 Englishmen and 12 Frenchmen can do in 95 days of 6 hours each, if 5 Englishmen can do as much in a day as 6 Frenchmen? (Q S. July, 1881.) As 5 E. = 6 F., 60 E. = 72 F., and 10 E. = 12 F.; hence 16 E. + 60 E. = 76 E., and 24 E. + 10 E. = 34 E. Having eliminated the Frenchmen by converting them into their equivalents of Englishmen, the question may now be read,—How many hours a day must 76 men work for 34 days to do a piece of work that 34 men can do in 95 days of 6 hours each?

$$\begin{array}{c}\text{hrs. m.} \qquad \text{d.}\\ \dfrac{6 \times \cancel{34} \times 5 \; \cancel{95}}{4 \; \cancel{76} \qquad \cancel{34}} = \frac{30}{4} = 7\tfrac{1}{2} \text{ hours. Ans.}\end{array}$$

As to the statement, the answer requires to be in length of day, hence the 6 hours given is first put down; and as 76 men will require shorter days, the greater number is put below the line; but as the number of days is less, only 34 against 95, the greater number is placed above the line. The two 34's cancel each other, and 19 divides 95 and 76.

As any question solved by Proportion may be worked out from first principles, we will bring our remarks on the teaching of Proportion to a close by thus working out the above exercise, making an hour's work the unit of operation.

$34 \times 95 \times 6 = 19{,}380$, hours' work in the whole.

$19{,}380 \div 34 = 570$, hours' work in 1 day by 76 men.

$570 \div 76 = 7\frac{1}{2}$, hours per day. Ans.

If we carefully compare this latter process with the former, we see that the operations are exactly identical, except the shortening of the work in the former by cancelling, and this cancelling is the chief advantage that Compound Proportion has over working by first principles, as it can generally be extensively resorted to.

(To be continued.)

Recent Inspection Questions.

[The Editor respectfully solicits contributions—all of which will be regarded as STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.]*

Arithmetic.

STANDARD I.

(1) Add together,—five, twenty-three, three hundred and nineteen, and seven. Ans. 354.

(2) From five hundred and six, take two hundred and eighty-four. Ans. 222.

(3) Add together,—thirty-six, seven, five hundred and fourteen, and sixty-two. Ans. 619.

(4) From six hundred and one, take one hundred and fifty-seven. Ans. 444.

STANDARD II.

(1) Take fourteen thousand and five from two hundred and nine thousand and four. Ans. 194,999.

(2) Divide twenty-one thousand and eight by eight. Ans. 2,626.

(3) Multiply four thousand two hundred and thirty six, by sixty-four. Ans. 271,104.

(4) Multiply 29,432 by seven. Ans. 206,024.

STANDARD III.

(1) Add together,—three hundred and twenty-seven thousand eight hundred and ninety-one pounds eighteen shillings and tenpence, and one hundred and eighty-seven thousand three hundred and sixty-one pounds six shillings and sixpence. Ans. £515,253 5s. 4d.

(2) Find the difference between fourteen thousand two hundred and thirty-four pounds sixteen shillings and elevenpence, and one hundred and sixteen thousand one hundred and sixty-four pounds and eightpence. Ans. £101,929 3s. 9d.

(3) Divide two hundred and sixty thousand nine hundred and forty-six by sixty-three. Ans. 4,142.

(4) Write in figures in *separate* lines,—seven, seventy, seven million and seventeen, and seventy thousand.

STANDARD IV.

(1) Reduce one hundred and fifty-one thousand five hundred and thirty-six pounds eight shillings and three halfpence to halfpence. Ans. 72,737,475.

(2) Multiply 204 tons 4 cwt. 1 qr. 17 lbs., by 45. Ans. 9,189 tons 18 cwt. 9 lbs.

(3) Reduce 205 years, 7 months, 2 weeks, 4 days, 2 hours, 32 minutes to seconds. (Note, 13 months = 1 year). Ans. 6,465,666,720.

(4) Divide three hundred and thirty-seven thousand one hundred and one pounds and ninepence by forty-seven. Ans. £7,172 7s. 3d.

(5) Bring 424 yards to poles, and then back to feet and inches, and explain clearly why you multiply by two, when you divide by $5\frac{1}{2}$. Ans. 77 poles $\frac{1}{2}$ yard and 15,264 inches.

STANDARD V.

(1) Find the value of 14,121 miles, 7 furlongs, 17 poles, $2\frac{1}{2}$ yards at £29 6s. 8d. per mile. Ans. £414,243 5s. 4d.

(2) If one yard of wire cost five shillings and fourpence, what will sixteen poles, two yards, one foot cost? Ans. £24 1s. $9\frac{1}{3}$d.

(3) Make out the following bill:— 7 oz. of tea at 4s. per lb., 16 lbs. of soap at 3d. per lb., 19 st. of flour at 1s. 6d. per st., and 100 quills at 5s. per 1,000.

£	s.	d.	
0	1	9	
0	4	0	
1	8	6	
0	0	6	
1	14	9	Ans.

(4) If 16 men build a wall in 4 days, how long will it take 28 men to do it? Ans. $2\frac{2}{7}$ days.

(5) Find the cost of two gross of pencils at one shilling and three halfpence per doz. Ans. £1 7s.

STANDARD VI.

(1) If $\frac{3}{4}$ yard cost $\frac{2}{3}$ of a sovereign, what will $\frac{2}{5}$ of an English ell cost? Ans. 8s. $10\frac{2}{3}$d.

(2) If five men paint a house in a fortnight, how many men will do it in 23 days 3 hours? (Note, 9 hours = 1 day). Ans. 3 men, if the fortnight = 14 days; $2\frac{4}{7}$ men, if 12 days are reckoned.

(3) Simplify:— $\dfrac{1\frac{2}{3} \text{ of } 2\frac{3}{4} \div 5}{\frac{2}{3}\frac{5}{8} + \frac{10}{8} - 1}$ Ans. $\frac{33}{34}$.

(4) How many half-crowns are there in 240 florins? Ans. 192.

(5) If half-a-crown will pay the carriage of 2 lbs. from Newcastle to London (272 miles), how much will it take to pay the carriage of 30 lbs. from Newcastle to Berwick (67 miles). Ans. 9s. $2\frac{115}{136}$d.

(6) Multiply $2\frac{2}{7}$ by $1\frac{31}{32}$, and subtract $4\frac{1}{27}$ from the result. Ans. $\frac{25}{54}$.

Grammar.

STANDARD IV.

Parse:—

(*a*) His sword of sharpness in his hand he took.

(*b*) One of the chickens went to the trough to drink.

STANDARD V.

Parse and analyze:—

(*a*) The humming bird in the picture is sitting on its eggs.

(*b*) There is great advantage in a long delay

STANDARD VI.

Parse and analyze:—

(*a*) The sea, which was very rough, soon went down.

(*b*) The children who saw it, fed it with crumbs.

Dictation.

STANDARD I.

Next day a friend came to see Jane, and once more the poor bird got no food.

STANDARD II.

The eggs are prepared for food in various ways, and some people are very fond of them. The shells also are made into cups and ornaments of different kinds. The ostrich is often hunted on horseback, but so rapid is its flight that the hunters would seldom succeed in catching it.

STANDARD III.

When the mother went to take a mournful look at her child's grave. On going to it, she found, to her great surprise, her lost dog. It was lying in a deep hole which it had scratched for itself over the child's grave, probably hoping to get a little nearer to the object of its affection. It was thin and weak, but hunger and cold had not overcome its love nor lessened the force of its attachment.

STANDARDS IV., V., AND VI.

The moon shone through the opening at the mouth of the creek by which I had entered the forest, and, considering this the best means of escape, I darted toward it like an arrow. It was hardly a hundred yards distant, and the swallow could scarcely have excelled me in flight; yet, as I turned my head to the shore, I could see several dark objects dashing through the brushwood at a pace nearly double to my own. By their great speed, and the short yells which they occasionally gave, I knew at once that these were the much dreaded grey wolves.

Publications Received.

Arithmetic—

(1) Bemrose's Standard Arithmetic. Parts I. to IV. Bemrose and Sons.
(2) Harvey's Examination Arithmetic. Blackie and Sons.
(3) Harvey's Key to Examination Arithmetic. Blackie and Sons.
(4) Knight's Algebraic Factors. Blackie and Sons.
(5) Longman's Modern Series Arithmetic. Parts I. to IV. Longmans, Green, and Co.
(6) Longman's Quarterly Arithmetic Tests. Standards II. to VI. Longmans, Green, and Co.

Domestic Economy—

(1) Warren's Cookery Cards for the Kitchen. Bemrose and Sons.

English Literature—

(1) Lewis's English Language. E. Stanford.
(2) Macaulay's Essay on Moore's Life of Byron. W. and R. Chambers.

Geography—

(1) Keith Johnston's School, Physical, and Descriptive Geography. E. Stanford.
(2) Meiklejohn's Geographical Reader. III. W. and R. Chambers.

History—

(1) Sanderson's History of the British Empire. Blackie and Sons.
(2) Young Student's English History Reading Book. National Society.

Miscellaneous—

(1) Landell's Boys' Own Toy-Maker. Griffith and Farran.
(2) Taylor's How to Prepare Notes of Lessons. National Society.
(3) The Cambridge Examiner. Nos. VII. and VIII. E. Stanford.
(4) The Public Schoolboy's Quiet Hour. Partridge and Co.

Music—

(1) Crampton's Songs for Young Singers. B. Williams.

Prize Books—

(1) Henty's Out on the Pampas. Griffith and Farran.
(2) Gellie's A Gem of an Aunt. Griffith and Farran.
(3) Bray's We Four. Griffith and Farran.

Periodical Literature—

(1) Ward and Lock's Universal Instructor. XII. Ward, Lock, and Co.

Reading Books—

(1) Longman's Illustrated Readers. I. to III. Longmans, Green, and Co.
(2) Longman's Poetical Reader. Longmans, Green, and Co.
(3) Edgeworth's Tales. G. Bell and Son.
(4) Beale's Great Englishmen. G. Bell and Son.

Science—

(1) Prince's Principles of Physiography. J. Heywood.
(2) Jago's Inorganic Chemistry. Longmans, Green, and Co.

Writing—

(1) Tidmarsh's Modern Copy Books. Longmans, Green and Co.

Engagements for November.

November	2.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
		Geological Society	8 p.m.
„	3.	Linnean Society	8 p.m.
		Education Society. Public Meeting.	
„	4.	Finance of Orphanage, N.U.E.T.	7.30 p.m.
„	5.	Meeting of Executive, N.U.E.T.	11 a.m.
„	7.	2nd B.Sc. Exam., London University.	
„	9.	Anthropological Society	8 p.m.
„	11.	New Shakspere Society.	8 p.m.
		Finance of Prov. Society, N.U.E.T.	7 p.m.
		General Board, N.U.E.T.	8 p.m.
„	14.	2nd M.B. Exam., Honours, London University.	
		Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
		Education Society. 'Joseph Payne as an Educationist,' by C. H. Lake, B.A.	7.30 p.m.
„	16.	Geological Society	8 p.m.
		Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
„	17.	Royal Society	4.30 p.m.
		Linnean Society	8 p.m.
„	18.	Executive Meeting, N.U.E.T.	
„	19.	Organisation Committee, N.U.E.T.	10 a.m.
„	22.	Scripture Examination, London University.	
		Browning Society. 'On Browning's Works,' by G. Barnett Smith, Esq.	
„	23.	Anthropological Society	8 p.m.
„	24.	Royal Society	4.30 p.m.
„	28.	Education Society. Open Meeting.	
		M.S. and M.B. Examinations, London University.	
		Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
„	30.	Royal Society Anniversary Meeting	4 p.m.

The Practical Teacher.

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The Editor cannot return rejected MSS.; authors should therefore retain copies.

*** *We regret that, owing to the great pressure upon our space, the 'Monthly Notes' and 'Gossip' are this month crowded out.*

Publications Reviewed.

*** We are sorry to disappoint the many friends who desire us to quote the price of each work noticed in our columns. This we would respectfully point out is the publishers' duty and not ours; we give publicity enough to a book when we review it. Our readers should peruse the advertisements in our pages, and failing to find the price here, it would be no great trouble or expense to drop a line to the publishers whose name and address we will gladly give.

Lectures on Teaching. By J. G. Fitch, M.A. Cr. 8vo, 436 pp. London: Cambridge Warehouse, 17, Paternoster Row.

FIRST NOTICE.

The Head-masters and the Assistant masters of our great public schools have been chiefly chosen from among the distinguished graduates of our universities, and the memory of their own school-training has been their principal guide in determining the methods which they have afterwards adopted. The traditions of the past have been of late greatly interfered with, not only by 'the spirit of the age,' which demands a more general culture than that which has been hitherto afforded in most schools, but also by the enforced introduction of a 'modern side,' which does not confine its attention to language and mathematics. To effect the greatest economy in 'power' as well as in 'time' requires much skill in school management, and this skill does not often 'come by nature.' The Senate of the University of Cambridge in 1879 appointed a 'Teachers' Training Syndicate,' 'with a view to encourage the study of the principles and practice of the art of teaching.' The volume before us contains the third series of lectures given to those members of the University who intended to adopt the profession of teacher, the preceding series having reference to the History of Education and Mental Science. Few men have had a more varied experience or a wider field of observation in reference to education than Mr. Fitch, and his opinions deserve far more attention than most of the imported theories which powerfully attract and dazzle, and then, like a passing meteor go into darkness. For all young teachers there is most valuable counsel in this book, and there are few experienced men who will not gain something from its perusal. The mere record of such sentiments as are scattered through the pages of this work issued from the Cambridge University Press is inspiring to those of us who have known what 'Teaching' has been in most 'colleges and schools'; and the ultimate national benefit which will result from the universal adoption of methods which 'shall make the work of honest learning and of noble teaching simpler, more effective, and more delightful to the coming generations,' is so vast as to challenge the attention of all who, like the author of these lectures, believe that in the art of teaching the discovery of scientific methods is possible, and their application practicable.

The fifteen lectures occupy four hundred and thirty-six pages, and treat of the Teacher, the School, Appliances, Discipline, Learning and Remembering, Examining, Preparatory Training, Study of Language, English Language, Arithmetic as an Art and as a Science, Geography and Fact-Lore, History, Natural Science, and the Correlation of Studies. Those who have studied the subject of Education in its modern developments will find no new or startling theory in any one of these admirable lectures. The results of long experience are presented generally in a clear light, and the methods by which good intellectual and moral training may be secured are sufficiently indicated. Mr. Fitch says, however, that 'this book is not, and does not profess to be, a manual of method,' but no attentive reader can fail to obtain from its pages much help in planning and developing the general or the individual parts of his school-work. Our space will not allow us to particularize, but each of the chapters is well worth a special study.

Here is a passage on the Ideal Teacher:—

'Now in regard to all the duties of life there has to be considered the correlation between the thing to be done and the doer of it; the qualities of the agent largely determine

the character and the results of the work. In all mechanical labour, in which matter alone has to be acted on, the physical strength and tactual skill of the artisan are the determining forces; his motives and moral qualifications have little to do with the result. But in the case of the schoolmaster, as in that of the priest, or of the statesman, mind and character have to be influenced; and it is found that in the long run nothing can influence character like character. You teach, not only by what you say and do, but very largely by what you are. Hence there is a closer correspondence in this department of human labour than in others between the quality of the work and the attributes of the workman. You cannot dissociate the two. And because in the profession of teaching the ruler or agent comes into closer contact with the person ruled than in any other profession, it becomes here specially needful to inquire not only what is the character of the work to be done, but what manner of men and women they should be who undertake to do it.'

And after showing the advantage of ample and accurate knowledge beyond mere professional limits, of a cheerful equable temper, as well as of quickness of eye and ear and of a cultivated voice, the author adds:

'And it need hardly be said here that the one crowning qualification of a perfect teacher is sympathy—sympathy with young children, with their wants and their ways; and that without this all other qualifications fail to achieve the highest results. The true teacher ought to be drawn towards the profession by natural inclination, by a conviction of personal fitness, and by a wish to dedicate himself and the best powers and faculties he has to this particular form of service. That conviction, if it once dominates the mind of a person in any walk of life, does much to ennoble and beautify even work which would otherwise be distasteful; but I know no one calling in which the presence of that conviction is more necessary, or its absence more disheartening than that of a schoolmaster. Teaching is the noblest of all professions, but it is the sorriest of trades; and nobody can hope to succeed in it who does not throw his whole heart into it, and who does not find a positive pleasure as he watches the quickened attention and heightened colour of a little child as he finds a new truth dawning upon him, or as some latent power is called forth. There is no calling more delightful to those who like it; none which seems such poor drudgery to those who enter upon it reluctantly or merely as a means of getting a living. He who takes his work as a dose is likely to find it nauseous. "The good schoolmaster," says Fuller, "minces his precepts for children to swallow, hanging clogs on the nimbleness of his own soul, that his scholars may go along with him." This means that he has enough of imaginative sympathy to project his own mind, so to speak, into that of his pupil, to understand what is going on there, and to think not only of how his lesson is being imparted, but also of how it is being received. But nobody can do this who is not fond of his work. That which we know and care about, we may soon learn to impart; that which we know and do *not* care about we soon cease to know at all, to any practical purpose.'

Mr. Fitch, when speaking of the choice of assistants, asserts that 'it is in the lowest class that the highest professional skill is often wanted.' We believe this so strongly as to say, unhesitatingly, that if our infant schools were under the best qualified mistresses the problem of popular education would be well nigh solved. Mr. Mundella, in his recent speech, rightly 'insisted upon better infant teaching—the foundation of all teaching'; and if the ultimate provisions of his new Proposals shall correspond with this expressed opinion, the Vice-President will have 'deserved well of his country.' The need of great skill in dealing with the minds of young children has been greatly overlooked.

The second and third lectures are full of valuable hints on the arrangements of the schoolroom, its 'comeliness, its furniture, and its adjuncts of library, museum, etc., which we cannot quote.

The important question of Discipline is discussed in the next chapter in great detail, but not more fully than it demands. The success of a teacher lies mostly in the character of his discipline. 'Force' may secure outward compliance with law, but how inferior is such discipline to that which wins a willing obedience through kindly 'personal influence.' Mr. Fitch points out the results of these opposite modes of government, but allows that 'it is better to gain obedience by force than not at all.' He shows the 'refuge of lies' to which impotent teachers betake themselves in entreaty, self assertion, threats, or futile appeals to a standard of moral obligation which the pupil is not able to acknowledge. Obedience must become a habit in school life, and the teacher's authority must never be questioned; his conduct should be so consistent as to inspire respect and confidence, and so correct as to be worthy of imitation. Some may be 'born to command,' yet

'Every one may acquire the power of ruling others by steadily setting himself to do so, by thinking well over his orders before he gives them, by giving them without faltering or equivocation, by obeying them himself, by determining in every case, and at whatever cost, to see them obeyed, and, above all, by taking care that they are reasonable and right, and properly adapted to the nature of childhood, to its weakness and its needs.'

Recreations, prizes, and punishments are discussed at some length, and certain theories refuted. With regard to punishments, the lecturer insists that they should be inflicted in such a manner that the child shall not be 'conscious of injustice.' 'Corporal punishment,' against which so many unpractical sentimentalists declaim, he does not denounce, but, nevertheless, asserts 'that it is almost wholly unnecessary, that it does more harm than good, and that in just the proportion in which teachers understand their business they will learn to dispense with it.' We agree with this, and believe that a *perfect* teacher will not need to use the birch.

'If your government is felt to be based on high principles, to be vigilant and entirely just, to be strict without being severe, to have no element of caprice or fitfulness in it; if the public opinion of the school is so formed, that a scholar is unpopular who does wrong, you will find not only that all the more degrading forms of personal chastisement are unnecessary, but that the need of punishment in any form will steadily disappear.'

A senior wrangler is not necessarily a good head master. Disciplinary power depends more on character than on culture.

The fifth lecture points out the conditions of 'remembering' what is learnt, and the principles which should determine the kind of lesson with which the memory should be taxed. The interest usually excited by oral lessons commends this form of instruction, and when the teacher has 'fluency, fertility, and quickness of resource, care in the choice of his language and a *lucidus ordo* in his arrangement, a power of putting the same truth in several different lights, a quick insight in discovering the difficulties in the learner's mind and in removing each difficulty when it occurs,' qualities which, with 'a certain tact,' are indispensable, there is, in our opinion, no mode so effective in permanent result on the mind of the pupil. The collective lesson skilfully given is the most valuable and efficient instrument at the command of the 'practical teacher' for true educational purposes. Suggestions as to bookwork and home exercises close this chapter. As might be expected, Mr. Fitch insists on the cultivation of the *rational* memory in preference to, but not to the neglect of, the *verbal* memory. He shows, for example, the little value of *beginning* grammar by learning the definitions. We once heard a distinguished French educationist say in accordance with this opinion: 'Commencer par la définition, c'est commencer la maison par le toit; la définition, c'est le sommet de la science.' The uselessness of 'learning by heart' answers in 'catechisms,' and of other similar 'memoriter' work, is made manifest in passages of merciless and merited vigour.

The lecture on Examining includes the 'Art of Questioning.' Who reaches perfection in this art has but little to learn. Principles and methods are indicated which, fully carried out in practice, will save both teacher and pupils a vast amount of trouble. Interrogation discovers difficulties, and may often lead to a rational perception of truth. This is illustrated at length in a Socratic dialogue. We do not find, however, any notice of the elliptical method of interrogation, one which is most useful with all children who have a limited command of language. Some wise cautions are given with regard to marking written exercises, but in these days when we are visited by an 'examination epidemic,' it is difficult for all teachers to act on the maxim: 'Take care of everything but the examination, and let the examination take care of itself.'

Preparatory Training is the title of the seventh lecture, and reviews the methods adopted in teaching writing, reading, and spelling. We sympathise with Mr. Fitch in a kindly regard for the Kindergarten.

'Experience shews that children who have been disciplined on this system, are found (1) to have got the rudiments of writing, counting and drawing, and to be better prepared for the ordinary subjects of school instruction than others; and (2) to have obtained in an indirect way a good deal of useful training which shews itself in quickened sensibility and prompter intelligence!'

The principles of the system should be more fully recognised by those who 'examine' our infant schools. The new proposals of Mr. Mundella seem to indicate some relief to the pressure now put upon the 'little ones,' and we trust that the joy of infant life will not be banished by any code from our public elementary schools.

The Teacher's Manual of Exercises in Mental Arithmetic. By Henry Hopkins, A.M., Ph.D. 245 pp. London: Simpkin, Marshall and Co.

This work, which is now in the third edition, is one which, on the face of it, bears evidence of a prodigious amount of painstaking labour and minute accuracy. Twenty-five thousand questions are propounded, and answers given to each. We have taken the trouble to verify some hundred or so of these answers, selected almost at random, and have as yet failed to meet with any mistakes. This gives a fair presumption that there really are very few indeed, if any, in the whole book.

The importance of Mental Arithmetic has, we humbly think, been both undervalued and overvalued; undervalued by those who scarcely teach the science orally, overvalued by those who, like our author, teach it to an excess, with the inevitable result of making calculating machines out of intelligent beings. Of the two courses, very probably the former is the more culpable. Parents meaning their sons and daughters to receive an elementary education only, do not as a rule desire more arithmetic and mathematics generally to be taught than will well fit them to avoid being cheated by the butcher or the draper. But this is, unfortunately, precisely the point where our young ladies' 'seminaries,' and some few boys' schools fail. We have ourselves seen housewives, who have newly acquired the dignity, pull out pencil and paper or memoranda tablets to reckon the amount of their bills, which, meanwhile, the shop-girl has done before the pencil makes its appearance. Or, if other evidence is required, turn to their account books and notice what an immense sum occurs in the column of 'items,' which, in most cases, may be more accurately described as unaccountable pence.

Any one who has had any experience in teaching will confirm this. For such an one's benefit we will add the further proposition—which, perhaps, he will be less ready to endorse—that he, as a teacher, too often assumes that previous teachers have done the necessary as far as mental arithmetic is concerned, which assumption has a result similar to the one in the well-known tale where the members of the synagogue resolved to present a cask of red wine to their new rabbi, each one to bring a pint of wine to fill it; and each one resolved to pour in water for his share, trusting that one pint of water would not be noticed in the midst of the thousand of wine. Judge of the rabbi's feelings on drawing a bumper of his congregation's munificent present. Judge also of the great, blank, staring white wall in the mind of the innocent upon whom this system of education has been practised.

This stricture does not apply to our elementary board schools, but we fear that our second stricture does, and with greater force. In them, perhaps, the study is overdone. Its advocates talk grandly about its sharpening the wits, and doing many other marvellous things. So, to a certain extent, it does, but to a certain extent only. A grindstone sharpens a chisel in a minute, but if you turn the grindstone till your arms ache your chisel will be no sharper than at the end of the first minute, probably blunter. Poor calculating Bidder was an idiot and a dunce when you set him to Latin. No good mathematician can work an arithmetical problem mentally, with speed and simultaneous correctness. And medical authority will bear us out in stating that there are sums which you can easily do on paper, but which will injure a child if you set them to him to do in his head. Some of these, we believe, occur in this book, and yet we have the author's word that he has or has had pupils who can do them all. To find the value, for instance, of *factorial sixteen*, *i.e.*, the continued product of 16 and all numbers less than 16, namely 20,922,789,888,000. Any boy who could do a sum of this sort in his head we should deem happier if some fairy wand could turn him into brass and figures and make a Babbage's machine out of him.

Or again, a titanic rule is given for finding the day of the week from the day of the month and the year. In the first place we have to find what our author calls the 'anticipation.' This might have been equally suitably called a hippopotamus, but that is a mere detail:—

'The anticipation is thus found: For the present century subtract 1820, 1848, or 1876 from the number of the year, according as it may be nearest above one or other of these numbers. To the remainder add its fourth part, omitting fractions. Reject the complete sevens from this total, and the remainder is the anticipation for the year.'

This learnt, and it is neither hard nor impracticable, we hear that the anticipation is the day of the week on which the month of September ends. We have now a series of numbers to commit to memory:—

Common year	0	3	3	6	1	4	6	2	5	0	3	5
Leap year	6	2	3	6	1	4	6	2	5	0	3	5

These numbers refer to the successive months of the year, and are baptized 'menstrual augments.' Thus 0 and 6 are the peculiar property of January, and so on. This table is not hard, at least not very hard to commit to memory. Now we are ready for the *finale*:

'Add together the anticipation for the year, the menstrual augment, and the number of the day of the month, reject the complete sevens, and the remainder indicates the day of the week, Sunday being the first.'

To commit such a rule to memory is, we think, the height of folly, considering that there are few circumstances where a reference to *Whittaker* could not be made more easily. Besides this, the table is unnecessarily complex. As it stands, the rule will not help us in the seventeenth century, and the adaptation which Dr. Hopkins makes for this emergency becomes simply hideous when applied to the seventh century. Why not say that the anticipation for any year whatsoever, a millennium hence as well as now, is the remainder, after dividing five-fourths of the year by seven? This seems simpler, and is easier in practice.

But by thus choosing particular examples we fear we have scarcely conveyed our appreciation of the author's merits. The book is on wretched paper, only fit for wrapping sugar; but this is not his fault. His part of the work is well done, and the publisher's part is well protected from the eye of the purchaser by a strong and serviceable binding.

We conclude by heartily commending this book to the teacher. We wish it all success.

Matriculation Questions on History and Geography, from 1844 to 1881. Collected and arranged by F. W. Levander, F.R.A.S. 155 pp. London: H. K. Lewis, 1881.

This little book at once prepossesses us in its favour by the extreme neatness of type, paper, and binding. In fact, it is by far the most pleasing specimen in this way that we have met for some time. And the author has the additional advantage that the subject-matter also is quite free from blame, or rather that the blame, if there be any, must fall not on him, but on the examiners of the London University. We have one objection only and may then dismiss this part of our task entirely. The classification

adopted for the questions in English history seems to us to be to a great extent frivolous and arbitrary. Firstly, we have the vague term, 'Principal Events,' which might mean anything, from the death of King Charles' spaniel to the wine-tub episode in which Clarence took such an unfortunate part. And then again, 'Succession,' which, we think, would far more aptly have come after, if not along with 'Ethnology and Genealogy,' which two latter subjects, by the bye, are no more intimately connected than Botany and Chemistry. Again this classification principle leads us very wrong when we come to Roman and Grecian History and Geography. Here we find questions asking us to write a commentary on the historical accuracy of passages quoted, or demanding a minute acquaintance with a historical point which the general reader would pass by and almost forget. The opinion a novice would form from this is that the matriculation is a remarkably hard examination and demands a vast and varied store of historical learning. But the fact is that these questions (in Roman and Grecian History) all have reference to the special subjects which had been previously given for the candidates' preparation and are therefore not half so difficult as at first sight they would appear to be. This fact should at least have been stated.

We advise the author, if a further edition is called for, to print wholesale and without alteration the papers as they were set at the actual examination. They would then be far more useful to the matriculation student, for whom, we suppose, they are chiefly intended, and quite as useful, if not more so, to the problem-lacking teacher, to whom, perhaps, they are subsidiarily directed.

The matriculation is an examination which, more than any other, demands thorough work and untiring application to wearisome details. It is the only one, so far as we know, in which the places are determined not by absolute marks but by absolute merit. Its Second Division is chiefly composed of men, the aggregate of whose marks would have placed them far above most in the first division, but who showed a culpable weakness in some one subject or a uniform mediocrity in the whole. On the other hand, its Honours Division is composed of a strange mixture of brilliant talent and dull-headed hard work, and often the latter will predominate. Ten marks out of a total of 2,800 will sometimes make a difference of two or three places in the Division List; so that, among the first few, the value of a single mark may be £5.

This being the case, a process near akin to 'cramming' is excusable, though, some will say, not advisable. And it is this process which we should tell any one who works for position merely to adopt; namely, a painstaking study of the papers of past years, so as to have at one's fingers' ends all the little hobbies of the examiners, and be able to foresee to a certain extent what questions would be set

That this process will pay we have no doubt. Equally little do we doubt that it is harmful and may fail of itself. Still a combination of the two is certain of success, and this, we believe, is the only true method of working for any examination. Do the subjects thoroughly, know every point, and then, not before, study the papers of past years so as to know on what to lay particular emphasis. This knowledge attained, be careful to keep the whole in mind and the candidate is well equipped.

Anyone who will conscientiously follow out this plan will find any compilation of questions, such as this, invaluable. Anyone who, having got these questions in his head imagines that he may on this account work one iota the less, is making a grievous mistake and had better have left them alone.

With these observations we commend the book to the reader. Mr. Lewis would do a great service if he were to reprint other papers—say those on English, Latin, and Greek Grammar.

Algebraic Factors: How to Find Them, and How to Use Them. By W. T. Knight, F.S.Sc. 80 pp. London: Blackie.

This work is an attempt to throw light upon a gloomy nook in Algebra. 'As a rule, this branch of the subject is hurried over with but a slight notice, both in books and in the schoolroom. Nothing could be more injudicious, since a true conception of factorial analysis enables the student to traverse with the greatest ease branches of Algebra which in other cases prove veritable Sloughs of Despond.'

No one can deny that Mr. Knight's intention was admirable, or that a book on the subject is very necessary. At the same time, we have several indictments to prefer against its execution, which we regard as more or less serious.

And at the very commencement we may give our opinion that our author and all subsequent authors on this subject would do well to adopt the newest notation which discriminates between '*is identically equal to*' and '*is, for a particular value, equal to*,' giving three horizontal strokes to the former, and only two to the latter. Thus we write—$(a-b)\times(a+b)\equiv a^2-b^2$; but an equation thus—$x^2-ax+b=0$. It is true that this alteration would at first present a little difficulty to the learner, but it is also true that it would render many passages in our modern text-books perfectly clear from being quite hieroglyphical, and would allow most average students to reach the meaning of a mathematical author without the aid of an expositor—a thing which is at present visionary to the uninitiated.

Since the sign '*is identically equal to*,' is also used as signifying '*is equivalent to*,' or 'may be replaced by,' we should often escape being plunged into confusion by the carelessness of an author. As, for instance, when Mr. Knight tells us, on p. 11—

'Here $a^3=8a^3b^6c^9$, $b^3=x^3$; hence $a=2ab^2c^3$, $b=x$, etc.' In this example, one only out of many, it takes any one who has not read the previous pages, an effort to see what on earth those mystical equations mean. He reasons thus—'$a^3=8a^3b^6c^9$ $\therefore$ $2b^2c^3=1$. Q. E. D. And what good is it?' Whereas, of course, it should stand—'$a^3\equiv 8a^3b^6c^9$, *i.e.*, $8a^3b^6c^9$ *may be replaced* by a^3, and thus we may apply the formula for the factors of a^3+b^3, where $b^3\equiv x^3$.'

Here there is no confusion, for it is well understood that in this significance of the sign cancelling is not allowable, nor is any algebraical operation except involution and evolution. Our first complaint about the book is that it is unnecessarily cumbrous. The theory of quadratic equations should have come first, and then the application to the factors of quadratic expressions. Mr. Knight's order cannot but lead the student wrong. He sees that x^2+2x+1, x^2+3x+2, x^2+2x, etc., all split up into real factors, and the poor fellow is sure to waste much time and bother a muddledom of a head to split up x^2+2x+2, or x^2+3x+1. All difficulties of this sort would be met by the reverse order. Besides all this, let the reader only turn to p. 19, where the unfortunate is initiated into the art of guessing factors of an expression such as $24x^2+46xy+21y^2$. After this, if he does not sigh for the friendship for quadratics, we are much mistaken.

A more serious charge is the next. Unconsciously Mr. Knight deprives the student of the power to think for himself by not giving him sufficient opportunity to exercise it. It is a mere piece of padding to repeat a formula already enforced, unchanged save by the alteration in sign of some member. Given any formula you please, the learner should be trained to deduce in his head, without writing it down on paper, the corresponding one formed by alteration of signs. Once known that $a^3+b^3+c^3-3abc=(a+b+c)(a^2+b^2+c^2-ab-ac-bc)$. We do not need to be told, as we are on p. 29, the factors of $a^3-b^3-c^3-3abc$, $a^3+b^3-c^3+3abc$, $a^3-b^3+c^3+3abc$. Surely it would have required no great genius to educe the last, at any rate, from the one preceding it—not to mention the rest.

There are many more complaints which we intended to have made, but we are compelled by space to make them merely in the form of suggestions:—

(1) The following rule should scarcely have been omitted or condensed to the comparatively useless form in which it appears on p. 24:—

'If $F(x)$ is divided by $x-a$, the remainder is $F(a)$, so that if $F(a)=0$, $x-a$ is a factor of $F(x)$.'

It is invaluable, as Mr. Knight must know, in complex factorial simplifications.

(2) The factors of the following expressions should have been more fully dealt with, each having some special importance:—

(a) $2a^2b^2+2b^2c^2+2c^2a^2-a^4-b^4-c^4$

(β) $a^3+b^3+c^3-3abc$.

We must now conclude. It requires either sublime genius or sublime luck to write a perfect mathematical book. About Mr. Knight's, all we feel justified in saying is, that it is far better than its predecessors, which latter compliment should be discounted by the fact that we do not remember having seen any predecessors.

Inorganic Chemistry, Theoretical and Practical. By William Jago, F.C.S. 202 pp. London: Longmans, Green, and Co. 1881.

Mr. Jago would seem to us, judging, at all events, from his preface, to be labouring under feelings rather inimical to the South Kensington Chemical Notation. We wish he had expressed these feelings a little more strongly, for notwithstanding his slight hint of dislike, we have still the eyesores of inconsistency which, in spite of all its evident merits, render the system worse than useless to some, and a very great hindrance to others. Notably among these eyesores is the occurrence of atomic instead of molecular symbols in equations. This is mentioned, indeed, on p. 95, but so far on in the work that it may be doubted whether the student will be able to revolutionise his ideas before he reaches the end. As a molecule is the smallest portion of a body capable of independent existence, and as all the molecules of the elementary gases contain two atoms, such an equation as

$$Hg+O=HgO$$

is nonsense, because the second symbol of the sinister cannot exist. It should, of course, be—

$$2Hg+O_2=2HgO\,;$$

not Hg_2, because mercury, zinc, and cadmium would seem to have only one atom in each molecule.

Here it is that the inconsistency of some of the men of the South Kensington School comes in. They rigidly adhere to this law for gases, but, for a reason known only to themselves, treat it with disdain when solids are concerned, and allow such equations as—

$$3Fe+2O_2=Fe_3O_4, \text{ or}$$
$$Fe_3+2O_2=Fe_3O_4.$$

Thus, to take a glaring example from a Matriculation paper,

$$H_2S+O_3=H_2O+SO_2$$

is said to represent the combustion of sulphuretted hydrogen in air, as if the air must be converted into ozone first!

But we must turn to our author's book, and may at the outset confess that although we were humbly of the opinion that if any book was wanted in the world it was not one on the theory of chemistry, yet we like this as well as any of equally small pretensions that we have yet seen. The list of contents embraces the following:— O, H, H_2O, H_2O_2, Cl, HCl, C, CO, CO_2, N, NH_3, S, H_2S, H_2, SO_4, and the oxides of N and S. Of course this list needs considerable alteration before the book can ever become a *vade mecum* for London examinations. It is also absurd to assign five pages to hydroxyl, while there is no mention of marsh gas or phosphorus. And, too, it is doubtful whether the science of chemistry—the firm principles, we mean, on which it rests—can ever be taught accurately by types selected in such an arbitrary fashion as this. But these charges lie at the door of the imperturbable geniuses at Kensington, not of Mr. Jago, and we may dismiss them with a mere mention.

The main feature of the book is its adaptation to laboratory work, in the first place by a series of numbered experiments introduced into the text, and to be performed by the student; in the second place by what are called 'Laboratory Hints,' appended to each chapter. The first plan, of course, is a not very new one; the second, in its present shape, we have not seen before. The hints are, of course, not quite perfect—here and there, in fact, absolutely faulty; still, they will do a good deal towards enabling private students to initiate themselves into the details of chemical manipulation.

The summaries are very lame performances. Our author needs to be reminded that in science a summary is rarely valuable to the student unless he makes it himself.

The standard attained throughout the book is much the same as that of Miller's 'Introduction to Chemistry,' published in Longmans' Science Series, rarely lower, and in the theoretical part much higher. In this latter Mr. Tilden's little manual has confessedly been largely used.

For its own purpose, Science and Art Examinations, we welcome this effort as a vast improvement in type, arrangement, and contents to its predecessors in the field.

French Nouns and their Genders, with a Complete Vocabulary of Exceptions to the Rules. By Thomas Goodman, assisted by MM. J. Ferrier and Alf. Hamonet. 64 pp. London: Simpkin

Our complaint against this book is that it is too complete, too extensive for any Englishman to be able to master it without spending more time upon the study than the French language as a whole is worth. It is nicely printed, and would form a very useful manual for reference if it were only decently bound. But to expect any man in his senses to learn it is to expect a sheer impossibility. The work is divided into four Sections— I. On Particular Nouns. II. On Class Nouns. III. On General Nouns. IV. This last is a farrago of various matters which either have or have not any connection with the genders of nouns or with nouns at all. We will examine the book in the order of these sections.

Section I. is made up of a 'List of Nouns which are Masculine in certain Significations, and Feminine in others.' This list contains 113 words, and will thus necessitate learning what is equivalent to almost 500 different significations. How formidable this looks; and yet what are the facts of the case? That about forty of these are important, and nearly forty wholly unimportant, rarely heard in ordinary conversation, and such that if met with in books, the context would at once declare the meaning.

Section II. is composed of general rules. Of these we observe that five or six, at least, look suspiciously like mere padding, as, for instance, on the first page, where six rules might certainly have been condensed into one. In this section comes a table of 'The Various Appellations of the Principal Animals, and their Young,' which for reference might be very useful, but which it is preposterous to expect to commit to memory. In the list of exceptions to the rule that 'Trees, Shrubs, and Bushes are masculine,' we notice several omissions, notably *ébène* and *viorne*. In the next rule, *Theiss*, *Tweed*, and *Neiss* are omitted, besides at least half-a-dozen rivers whose names end in *a*. *Mousson* is omitted from Rule 13. Rule 14 might have been shortened to:— 'Names of Mountains are Masculine, except names which are plural in form.'

But it is useless to go on complaining about geographical genders. If the French discover anything new in the world they seem to toss up for its gender, and for aught we know, Mr. Goodman may have persuaded a French author to make *Tweed*, for instance, masculine in his book, and thus sanction a perpetual usage. It is the merest truism to say that this branch of genders are in a simply ridiculous state. When rules proclaiming that distant countries are one gender and near countries another are given to their pupils by French masters apparently in their senses, we need no further accusation against the language.

And so we might struggle on with Section II., but let us leave it for new pastures. At Section III. we confess

we were horrified. The average number of exceptions to the various rules is about fifty. Now and then, by way of variety, Mr. Goodman will double this number. Out of forty-one rules, throughout orthographical and not determined by meaning, only seven are blessed with no exceptions, while the last of the forty-one, which may inspire affection because it is the last, has the small sum of 150 exceptions. Thus, we are not far wrong when we say, guessing roughly, that the total number of exceptions, all to be committed to memory, falls little short of a thousand. Notwithstanding this, *not more than* 300 nouns are used in the conversation of ordinary people, so that we cannot but think it a work of supererogation to learn off all this titanic collection of forty-one rules and a thousand and one exceptions.

We have not, we confess, read this section throughout, for we almost shrunk from looking at it, so that we cannot say whether it is complete or not. For our unfortunate student's sake we may hope that there are no more additions to be made.

Section IV. is in no sense novel, and may be dismissed without further mention.

We are sorry that we cannot speak more favourably of a work which must have demanded a vast amount of care, attention, and time. 'Seven years' laborious research' seem to us seven years nearly wasted, likely, at any rate, to produce very little fruit. 'The means of acquiring, with hitherto unknown rapidity, an accurate and ready knowledge of the genders of nouns of the French language,' are, we think, still undiscovered, and taking into account the fact that not half the French nation itself, even the educated classes, knows its nouns thoroughly, these means are possibly undiscoverable. That this book 'will be found singularly useful as a *vade mecum* for the desk of the correspondent or the pocket of the tourist,' is a hope which can never be realised, because any good dictionary will do thirty times as well.

We will conclude by suggesting that the only true method for teaching French genders, is the same as that adopted for teaching German, to learn the article with each word. It cannot be otherwise when the whim of an ignorant set of Latin soldiery has reversed the fate of many of the words which might otherwise have had a chance of reaching France undefiled.

Primer of Industrial Geography of Great Britain and Ireland. By G. Phillips Bevan, F.G.S., F.S.S. 109 pp., 2nd. ed. London: Sonnenschein and Allen, 1880.

We always have very great sympathy with any undertaking of this sort, and are glad now to notice that Mr. Bevan's useful little manual has reached a second edition.

Geography, more than any other subject, is at the present day outrageously mistaught. Your average teacher will, book in hand, instil into the more or less miserable urchins around him name after name of obscure cape or unintelligible tribe, which it is as little likely that said urchins will ever in their lives come across, though they travel from pole to pole, as it is likely that they will explore and map out the gulfs and inlets of the bed of the mid-Atlantic. Of course, it is very pleasing and interesting, and all that sort of feminine thing, to know that Everest is the highest mountain in the world, or that Guadalquivir is not in the Friendly Islands, that crossing the line does not mean running over a rope, or that it is not true, though the Editor of the *Manchester Courier* says it is, that the South Pole is hot, because it always does get hotter as you go further south. But, at the same time, we affirm that it is infinitely more important to know where you change in any common railway journey, or in how many ways you can get from Newmarket to Liverpool, say. And it is just this branch of geography that is systematically neglected. One reason, and, in its way, a fairly good one, is that teachers themselves don't know it. Of course, in that case, the wiser course is not to teach it. Still, there is no excuse for their ignorance. It is really pitiably comical to go any ordinary railway journey and unobtrusively to inquire the destinations of your fellow passengers. Suppose we try from Bristol to Derby, by the fast express. An old gentleman seated just opposite is going to London via Birmingham, and may arrive within five hours of the time when the Great Western would have taken him. At Mangotsfield another gets out and changes for Bath, intending at Bath to change to the Midland and South Western Joint for Templecombe, eventually to land at Exeter. The 'Flying Dutchman' meanwhile does it from Bristol in half the time. We do not stop at Gloucester, and at Cheltenham there are sure to be half a dozen who meant to get out at Gloucester, preferring that way to South Wales, to crossing the Channel at Newpassage and Portskewet. And so we might continue. These are not ideal cases. We have seen specimens of each. We do not hesitate to say that they are of daily occurrence.

Not less extensive, though, perhaps, less culpable, is the ignorance of the great trunk roads of England. Put a man on a bicycle, give him no map, allow him merely to ask the names of the villages through which he passes, set him off at London and tell him that you will meet him at York. You may smile as grimly as you like, but except your man is one in ten thousand, you will as probably find him at Exeter, or Southampton, or Margate, as at York.

Really, it is a serious matter when the little children out in New Zealand know the geography of England better than those who are brought up in its village-schools.

Closely linked with this is the 'Industrial Geography of Great Britain,' and it is for the reasons that we have just been explaining that we accord a hearty welcome to Mr. Bevan, and only wish he had made his book bigger. We hope that our author, if he do not see fit to adopt our recommendation in this, will at any rate some time or other find his way clear to publishing a little manual of the railways of Great Britain, which may consist of an expanded edition of the neat little summary in Chapter ix.

We have left ourselves space to say but little about the workmanship of the book, and all that little is congratulatory. The get-up is extremely neat, and the contents interesting always, rarely tabular, but never on that account shallow. All success to any venture which, by making prominent the geography of England, annihilates the absurd and utterly pernicious theory that to know the position of Denver City, or any conceited little shanty which, great or small, calls itself a city and has not learnt to build of stone, is more important than to know your way from the Marble Arch to the Bank, or through the mazes of New Street Station.

Pictorial Atlas of Nature. London: Ward and Lock.

This attractive book is one of the best aids to Geography that can be met with. Of course we here speak of Geography in a very different sense from the mere collection of names of places associated with—more or less understood marks on maps. These latter have their uses, and cannot be dispensed with, but the knowledge of the people, plants and animals, and other productions of different countries, together with physical features, have in too many cases been thrust aside, as forming useful reading about geography, but not indispensable to the science itself. Happily these so-called accessories are now being justly regarded as the most important features of geography, and taking this view Messrs. Ward and Lock have done great service in the very attractive book before us. The illustrations constitute a leading feature of this book, and are carried out with uniformity of plan that contrasts favourably with the mere collections of wood engravings that are often thrust forward to do duty over and over again in all sorts of books and on all sorts of subjects. Here we have systematic pictorial representations of the types of the people of the earth or families of the human race as they are distributed over the various regions of the earth, with accompanying descriptions.

These are followed by similar representations with explanatory text of *Animals*, and next of Plant Life. These are variously grouped in separate chapters relating to Europe, Asia, Africa, North and South America, and lastly of Australia. The collection has been taken from a large mass of material, and has been thus collected with care and judgment. No less than 500 well-executed wood engravings form the illustrative portion of this admirable volume, and these are accompanied by terse and accurate explanations, together with maps carefully figured to exemplify the references in the text. Illustrations, maps, and text are all presented together on one sheet, whereby the trouble of turning over for frequent reference is avoided and on this plan not evaded. Few books will be found so useful to the student, and at the same time so attractive to young people.

Notes on Exodus. For the help of Bible Students. Laurie's Kensington Series. London: Thomas Laurie. Stationers' Hall Court.

When we mention that Mr. Fleming, the author of these notes, has laid the best modern authorities under contribution, including the learned Hebrew, Dr. Kalisb, we say sufficient to show the value of this little book. It is of course limited to explanatory features to the avoidance of controversial topics. The most salient points of the dispute, how much of the book of Exodus (the *Shemoste* of the Hebrews) was written by Moses, and what additions were made by Ezra and his fellow scribes or compilers is briefly and fairly stated. The main portion of this book consists of explanatory notes and verbal elucidations, which are clear and to the purpose. A brief analysis, followed by a general index, completes the little volume. The 'ark of bulrushes' in which the infant Moses was committed to the river is thus described:—'An *ark* or chest of *bulrushes*, *i.e.*, of the papyrus, which was formerly used in Egypt for light boats. It does not now grow in Egypt. It is a strong rush, like the bamboo, about the thickness of a finger, not quite cylindrical, but three cornered, and attains the height of ten to fifteen feet.' The direction given to Moses to put off his shoes is explained from Kalish as an act of courteous reverence similar to the uncovering of the head by western nations. The facility by which the eastern shoe could be removed by the mere untying of the sandal, should be remembered in this explanation. No one will question the gain in the thorough understanding of the sacred writings by profound scholarship, aided by an extensive knowledge of Eastern manners and customs. Every year adds to this fund of information, and the book before us places such investigations at the use of the humblest student.

A School Physical and Descriptive Geography. By Keith Johnston. London: Edward Stanford, Charing Cross.

This valuable work must take a leading place among modern school geographies. The name of Keith Johnston is sufficient to claim attention to its pages, and the care and completeness of the work itself fully justifies the high opinion held of the author's reputation as the most able exponent of geographical information. The book before us—though an abridgment of the author's larger work—occupies upwards of 400 closely, though clearly and excellently-printed, pages. This abridgment is mainly formed by the omission of most of the historical features of the larger geography, together with most of the elaborate maps. Of these latter illustrative aids, the work before us contains a fair portion, though less than we could desire, from the valuable collection available that form part of the larger work.

The compendium before us will be especially valuable to students and pupil-teachers. Its style is more advanced than that of ordinary class-books on geography, and its information more extensive than lying within the scope of junior classes. This is a merit, considering the capabilities of those for whom this book is designed. By a thoughtful study of its pages, pupil-teachers will be able to pass their examination with credit.

The physical portion occupies as usual the first portion of this book, and has a capital introductory chapter on the formation of maps and plans from observation made in rural walks. The points of the compass, and invariably of the polar star, are here clearly shown. This is followed by a capital exercise for the formation of rough maps from descriptive notes. This kind of work will, we trust, become much more common. The astronomical portion is treated with remarkable clearness, as also the circulation of the air and waters. The tides, however, are dismissed in less than a dozen lines, with the remark that 'it is only along the immediate shore that the tidal undulation is converted by the opposing land into an actual forward or sideward movement of the water. The tides play but a very insignificant part in the movements or interchange of the waters, and have no appreciable influence in modifying the climate of any part of the globe.' Very true, but the tides have a considerable influence in modifying or changing the contour of almost every coast-line, and should not be cursorily dismissed, though of no influence in regulating climate.

In the Descriptive Geography, the author wisely introduces the outlines of the physical features of each of the great divisions of the globe. These are relieved from dulness by such lively and suggestive remarks as the following:—'Throughout the summer the table-lands of Castile, bare and treeless, are burned up by the hot sun, but through the chilly winter they are swept by violent winds. The herdsman, who wears a broad-brimmed hat for protection against the excessive heat during the day, a few hours later puts on his thick, warm cloak; in the same way, after the almost summer, follows a cold winter, with ice and snow.'

In speaking of the inhabitants of England, the author does not repeat the exploded theory of the Britons being exterminated by the invading Jutes, Angles, and Saxons, but wisely remarks—'Thus the population of the British islands is a mixed Celtic, Germanic, and Romanic one, all its elements being more thoroughly amalgamated in the populous lowlands of Britain, the Celtic remaining purer in the highland regions, which are more difficult of access. In Ireland the Teutonic element prevails along the eastern margin; thence toward the western mountains the transition is gradual to the pure Celtic.' In regard to education, many would demur to the remark that 'the manufacturing and mining portions of England are lower in the educational scale than the agricultural.' Generally speaking, the political portion of this geography is treated less extensively, though far more readable, than in most other books of the same character. Indeed, throughout, the book is thoroughly readable, and not disfigured by dry columns of names and figures. The derivation of the most important names is given in footnotes, together with more ancient names in many cases, as, for instance, Cale (or Cales), the ancient name of Oporto, and thus arose *Portugal*, from *Portus Cales*, the name of the whole country. Speaking of the people of Lisbon, the author says: 'Unlike Madrid, where everyone is Spanish, the cosmopolitan port of Lisbon is thronged with white and negro, English clerks, bearded Jews, and weather-beaten sailors of all nationalities. Oporto is busiest in sending the wine of the Douro valley to England.' In such lively fashion does the author carry us with him through his instructive pages. The wretched state of popular education in Italy is very properly alluded to by Mr. Johnston, and the efforts now made for its improvement by means of the funds obtained from useless monastic establishments.

We might go on adding quotations of well-written passages, in which new truths are expressed or old ones happily uttered, did space permit. Altogether this book cannot fail of making its way and doing much to elevate the teaching of geography from its former dry and undignified position. A good index forms a necessary feature at the end of the book.

Examination Arithmetic. Fcap. 8vo. 158 pp. **Key to Examination Arithmetic.** Cr. 8vo. 274 pp. By T. S. Harvey. London: Blackie and Sons, Old Bailey.

We are always glad to see schoolbooks penned by experienced and successful teachers. The one before us—designed primarily as a coach for examinations—reveals on almost every page the hand of the practised craftsman. In this admirable volume Mr. Harvey has collected and arranged in a graduated form, over twelve hundred arithmetical questions culled from the Oxford and Cambridge, College of Preceptors', pupil teachers', scholarship and certificate papers, thus furnishing a most excellent examination course. To head-masters who set periodical tests, and to the private student anxious to figure well on the list it will be invaluable. The key, which contains the full working of the sums, has the additional merit of showing how the problems should be set down on an examination paper. We have no hesitation in saying that of all the examination arithmetics which have come under our notice—and they are not a few—this is by far the best.

The Messrs. Blackie have sent forth these two books in the same faultless manner as the various volumes in their now well-known comprehensive series.

Bemrose's Standard Arithmetics, for Standards 1, 2, 3, 4. London: Bemrose and Sons, Old Bailey, E.C.

On the title-page of these neat-looking little books we are informed that they are 'adapted for teaching and testing.' Mr. Maxlow, the compiler of these arithmetics, has done his work in a highly creditable manner. They contain a vast number of exercises, many of which—wisely, we think—overstep the bare requirements of the code. At the end of each book a capital selection of 'Miscellaneous' questions is given. A child who works through these sums, and can 'do' them 'right,' need fear no examination of a reasonable inspector. The answers to the four parts are issued in one book.

PRIZE BOOKS (First Notice).

School Days in Paris. By Margaret S. Jeune. London: Griffith and Farran, St. Paul's Churchyard.

We place this at the head of a batch of attractive books that gladden the eyes of many boys and girls at the Christmas holidays. Very many of these reward books remain unread on drawing-room tables on account of their being either too sermonising, too dull, and in not a few instances too childish. We rejoice that in most of the little volumes before us these faults are avoided, while the morbid sensationalism of cheap trash is as sedulously shunned. To interest and amuse without appearing to instruct and moralise is by no means an easy task, but which, nevertheless, has been admirably exemplified by many writers, from Mrs. Hofland down to the late Mr. Kingston. Of this juvenile literature the names of Griffith and Farran worthily occupy the place of their renowned predecessor, Mr. Newbery. In addition to the attractions of the literature and illustrations, the pretty covers of several of the books before us are by no means to be lightly esteemed. Branches of trees with twigs bearing silver cherries and sprays bearing equally attractive flowers form the designs of several of Messrs. Griffith and Farran's pleasing volumes. The author of 'School Days in Paris' is less amusing than descriptive, but very readable from his plain truthfulness. The fare, if we may take this as an example of French school diet, was by no means attractive, indeed we should say scarcely nourishing. 'Our fare was very simple, and although well cooked, not prepared *à la* anything to be found in Soyer. Our breakfast, at half-past seven (we got up at five in summer and six in winter), consisted of vegetable soup, sour bread without butter, and water. At twelve o'clock came the second *dejeûner*, when the usual fare was potatoes and carrots boiled together, red or white cabbage, lentils, in the season large dishes of peas and asparagus, or occasionally cold meat served with oil. *Eau rougie* was our beverage; that is to say, water with just enough wine in it to change the colour. At five o'clock we dined on soup *bouilli*, sometimes a roti, vegetables and a dessert of bread and preserves. This ended our meals for the day, for tea was unknown, except on Thursday evening, our half holiday—tea, at least we called it, though its claim was very doubtful. However, it was warm and sweet and comforting, although sent up in a tin can.' This is not very attractive, and we believe much of the physical weakness of girls is owing to insufficiency of generous diet. Speaking of the custom of husbands being selected by parents, the following remarks will at least amuse if not furnish material for reflection:—In French school-girl life there is an 'entire absence of the chattering confidences concerning supposed admiration, lovers, etc., which in even the best-regulated English schools forms the staple of English conversation of recreation hours.' The asserted absence of 'nonsense of this sort' is thus explained by one of the French pupils. 'What is the use of our troubling ourselves about such matters? Our parents' wisdom will do far better for us than we could do for ourselves. We know nothing of the husband selected for us, but neither do we know anything of any one else. With you English, being aware that your chance of marrying depends in a great measure upon your own powers of attraction, you therefore begin early to exercise them, and the subject exercises your thoughts continually, because the future is still all uncertain, and you never know when or where the future lover or husband will appear.' All this sounds plausible. It is, of course, far too prettily expressed to be taken *au pied du lettre;* but that may pass. It concerns all heads of schools, English or foreign, to check this asserted tendency in young ladies to be continually thinking and 'chattering' about marrying by providing sufficient mental occupation, relieved by judicious and cheerful employment, for leisure hours. The greater portion of these pages are much less argumentative, and contain lively pictures of French places and society. The book altogether is full of good honest fun, and the authoress possesses in no small degree an easy and graceful style, which, while often discursive, is never too colloquial.

Salt Water. By W. H. G. Kingston. London: Griffith and Farran.

Here we have another capital book about the sea and sailors by the lamented Mr. Kingston, who has done as much in making seafaring life popular among boys as Dibdin did in popularising the old naval service by his famous sea-songs. The hero of the tale was initiated into the details of a ship and its fittings by his faithful attendant, Larry Harrigan, whose early teaching did much to induce young D'Arcy to choose the sea for his profession. The lessons of Larry were brought into use at the outset of D'Arcy's career. The youth, finding himself in the company of some naval officers at Portsmouth, was twitted by them with being quite a novice in all things relating to the sea. The youth astonished his querists by his accurate knowledge of a ship and its rigging. His friend Larry accidentally discovered his long lost wife in the character of a lodging-house keeper at Portsmouth. From this happy commencement we are led through exciting scenes, involving hair-breadth escapes, and giving us striking pictures of sea life and adventure. The villain of the book, Bill Myers, pursues a career of crime as smuggler, pirate, and murderer for some time, till brought to bay by the hero, D'Arcy. Paralysed by the unexpected rencontre, Myers leaps overboard and becomes the prey of sharks. While the attractions of the sea are duly acknowledged, its dangers and trials are also pointed out. Whether our boys follow D'Arcy's example in becoming sailors or not we cannot of course determine, but we can assure them that they will read the book before us with unfeigned delight.

Our Birthdays. By Emma Davenport. London: Griffith and Farran.

This little book has a moral and religious tone. Lessons of improvement are given, mostly by way of narrative dialogue, interspersed with information on old illuminated books and other readable matter, together with a fair amount of incidents in the daily life of amiable and teachable children. The explanation of precepts from the book of Proverbs occupies a considerable portion of this little volume, but these explanations are given with judgment and a most kindly spirit.

Stolen Cherries. By Emilia M. Norris. London: Griffith and Farran.

This little tale describes the ill consequences of falsehoods to hide faults and accidents, whereby a downward course is continued until the consequences become very serious. A confession is then made and forgiveness bestowed upon the repentant boys instead of the expected punishment. Young readers cannot be otherwise than wholesomely impressed with tales of this kind.

Holidays Abroad. By Emma Davenport. London: Griffith and Farran.

Under the guise of holiday tours, this book fairly describes scenes in Paris and other places in France and also in Italy, with a sprinkling of incident and very much moralizing. 'Cousin Kate' talks in the goody and sententious style, which, though always instructive, is hardly sympathetic enough to be very attractive to children.

The Hero of Brittany. By Emile de Bonnechose. Translated by Margaret S. Jeune.

This book, as indicated above, is a translation of one of the histories ot Emile de Bonnechose. The translator may be congratulated on the scholarly way in which she has done her work. Without departing too far from the original, she has succeeded in giving us a thoroughly readable and faithful translation. We have little doubt that the book will be eagerly read by many, who though unable to study the French original, would still enjoy reading the history of a period from a French historian's point of view. What portions of the life of Bertrand there are, which bear the stamp of improbability to us matter-of-fact people of the nineteenth century, may fairly be left to the judgment of the readers of this book, to retain or reject as they think fit.

The criticism of Monsieur de Bonnechose's book as a history does not at present concern us. He is well-known to the reading public as one of the most delightful of French historians. Apart from his theories, he has given us a most lively and picturesque view of the events of France at that time, and our thanks are due to Margaret Jeune for giving to the world so graceful a translation.

Cassell's French-English and English-French Dictionary. Crown 8vo. 1,122 pp. London: Cassell and Co., Ludgate Hill.

Probably some of our readers will smile at seeing a 'Dictionary' placed under the head of 'Prize Books.' Now that a fresh impetus is being given to the study of French, there must, however, be thousands of young teachers to whom this book would prove a veritable godsend as compared with a story-book, no matter how well written or beautifully illustrated it might be. So far as we know, it is without a rival, and a perfect marvel of cheapness. We strongly recommend this French dictionary as being well worthy of a place in every teacher's library.

Claudine; or, Humility the Basis of all the Virtues. By a Mother. London: Griffith and Farran.

The brilliant binding and pretty get-up of this little volume are only the exterior adjuncts of a tale which will prove highly interesting to all story-loving children. When we say that the work has reached its tenth edition, our readers will feel assured that it forms an admirable gift-book to a child fond of reading. The authoress evidently knows from experience how to provide mental food for children, and she has produced a work here which every child will be proud to keep in its own particular library. The plot is interesting, the characters are well drawn, and the moral is one which cannot be placed too often before the minds of young people.

Distant Homes; or, the Graham Family in New Zealand. By Mrs. J. E. Aylmer. London: Griffith and Farran.

The story written in the pages of this attractive and prettily-illustrated volume is of a family who were obliged, through financial difficulties, to leave their home in England and emigrate to a far distant land. We have a good account of their voyage to New Zealand, and a very faithful picture of the manners and customs of the aboriginal inhabitants of that country. There are one or two of those thrilling incidents which are generally to be found in stories of this description, and we can promise all those who take the book in hand that they will pass a very pleasant half-hour with Mrs. Aylmer.

Fickle Flora and her Seaside Friends. By Emma Davenport. London: Griffith and Farran.

Miss Davenport has produced a story of the stay of some little girls at the seaside which, we have no doubt, will be read with avidity in these long winter evenings by the children who so largely swell the population of our marine towns during the summer months. They will be reminded in reading these pages of the pleasant time they themselves passed during their annual stay by the great deep; while the little brothers and sisters who have not yet had an opportunity of catching tiny crabs and picking shells on the beach, will look forward with much anxiety and anticipation to the time when they will be able to do so. We could wish that the illustrations had been done in a little better style; but apart from this the book has no drawback, and we heartily recommend it to our readers.

Out on the Pampas. By G. A. Henty. London: Griffith and Farran.

In spite of the number of books there are of this class of literature, Mr. Henty has found something new to tell us in his interesting work. The novel idea of an English family, who, though in a good social position, can hardly contrive to make both ends meet, and therefore decide on emigration, is well worked out. We are soon settled with the family, so to speak, in their new home in South America. Their social life here, their various adventures in hunting, their troubles and trials are told with a charm of manner that reminds us of the works of the very best writers in this department of literature. Mr. Henty's characters too are pleasantly and clearly drawn, and his young ladies contrast most agreeably with the insipid portraits that it has been too often our hard fate to meet with in fiction. Mr. Henty takes us with him through a series of stirring adventures, which contributes in the highest degree to the success of the story, and keeps us in a constant state of curiosity as to what is going to happen next. To detail these adventures would not be fair. Suffice it to say that the story never becomes tedious, and by careful variation in the incidents, interest is kept up to the last.

Words by GEORGE BENNETT.

ON THE BEACH.

Music by T. CRAMPTON.

Pupil Teacher's Examination Questions.

AUGUST, 1881.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May,* 1878; **and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. On selling 4 dozen cucumbers for 13s. 0d. a profit was made equal to three-tenths of the money laid out in buying them. What ought the price charged per cucumber to the customer to have been, in order that 60 per cent. should be gained?

2. What is meant by 'discount'? What is the discount on £1,250, due 9 months hence, at 5½ per cent.?

3. In 3 years, at 4 per cent., what sum would £1,080 amount to at compound interest?

4. If by selling an article for 8s. 3d. I lose 17½ per cent., what should I have sold it for to gain 40 per cent.?

5. Explain the following quotation from the *Times* of November 29th:—'Consols opened this morning at a fresh decline of an eighth, and ultimately experienced a further fall. The first bargains were at 89⅜ to ½, and the last at 89¼ to ⅜. For the 7th of December the final quotation was 87⅞ to 88 ex. div.'

FEMALES

1. A house which cost £1,500 lets for £65 a year; the outgoings for insurance, etc., amount to 1¼ per cent. on its cost; what rate of interest does it pay?

2. An innkeeper uses a quart measure which is too small by ·375 of a pint; of how much will he defraud his customers in selling a butt of beer if he charges 2½d. for a pint?

3. The sales of a bookseller amount to £25,000; one-fourth of the sales are made at a profit of 25 per cent., seven-tenths at a profit of 16⅔ per cent., and the remainder at a loss of 25 per cent. Find the cost of the stock sold.

4. Three cowkeepers hire a pasture for £35 7s. 6d. for 26 weeks; during the time A puts 7 cows in it for 13 weeks, B 14 cows for 9 weeks, and C 3 cows for 22 weeks. How should they divide the rent?

Grammar.

1. *Be useful where* thou livest, that they may
   Both want and wish thy pleasing presence still.
   Kindness, good parts, great places, are the way
   To compass this. *Find out men's wants* and will,
   And meet them there. All worldly joys go less
   To the one joy of doing kindnesses.

   GEORGE HERBERT, 1633.

   (*a*) Write out the meaning of the above in your own words.
   (*b*) Parse the words in italics.
   (*c*) Analyse the first two lines.
   (*d*) How is the word *that* used in the first line? Give examples of the different ways in which the word *that* is employed.

2. Mention some of the classes of words in our language which are generally of Latin origin. Give examples.

Geography.

1. Draw a full map of Africa, *to the east of the 30th meridian of east longitude*—that is, to the east of Alexandria on the north, and of Port Natal on the south.

2. Describe fully the great mountain chains of America, and trace the courses of the principal rivers that rise in them.

SECOND PAPER.

One hour allowed for Females, two hours and a half allowed for Males.

History.

1. How were the Jews treated under Richard I.? Explain the feeling towards them.

2. By what authority were the Stuarts restored in 1660, and William and Mary placed on the throne in 1689?

3. Mention the chief military achievements of this country from 1704 to 1709, and explain the cause of the war of the Spanish succession.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible.*

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act,* 1875.

Composition.

Write a short essay on *The Navy.*

Euclid.

[The only abbreviations admitted for 'the square on AB' is 'sq. on AB,' and for 'the rectangle contained by AB and CB,' 'rect. AB, CD.']

1. If the sides of any hexagon be produced to meet, the angles formed by these lines are altogether equal to four right angles.

2. If a straight line be divided into two equal parts, and also into two unequal parts; the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

3. If a straight line be bisected, and produced to any point, the square on the whole line thus produced, and the square on the part of it produced, are together double of the square on half the line bisected, and of the square on the line made up of the half and the part produced.

Algebra.

1. Reduce $\left(\frac{x^2 - 9x + 20}{x^2 - 6x}\right)\left(\frac{x^2 - 13x + 42}{x^2 - 5x}\right)$ to the simplest form.

2. Solve the equations:—

$$(1)\ \begin{cases} ax = by \\ x + y = c \end{cases}$$

$$(2)\ 12x^2 = x + 1740.$$

3. Find two numbers in the proportion of 8 : 5, the product of which is 360.

Mensuration.

1. The paving of a semi-circular alcove with marble at 2s. 6d. a foot came to £10; what was the length of the semi-circular arc?

2. Find the area of a regular hexagon whose side is 15 feet.

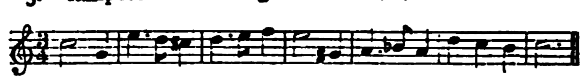
Music.

A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of E (*Mi*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.

2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms.

3. Transpose the following into B flat (*Se*).



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. $\frac{13}{10}$ of buying price = 13s.

$\therefore$ the buying price $= \frac{13 \times 10}{13} =$ 10s.

To gain 60 p. c. the 48 cucumbers must be sold for 10s. × $\frac{160}{100}$, or 16s., *i.e.*, $\frac{192\text{d.}}{48}$, or 4d. each.

2. There are two kinds of discount, namely, the *usual discount*, which is just interest on the amount of a bill or debt for the time it has still to run, and the *true discount*, which is the *interest* on the present value of the bill or debt. The latter is less than the former by the interest on the *true* discount.

To find the true discount on £1250, for 9 mos. at 5½ p. c.

(*a*) 12 mos. : 9 mos. :: £5½ : 4⅛ interest of £100 for 9 mos., or £4⅛ is the discount on £104⅛ for the given time.

$\therefore$ £104⅛ : £4⅛ :: £1250 : discount required.

£1250 × $\frac{33}{833}$ = £49 10s. 4$\frac{628}{833}$d. Ans.

3. 4 p. c. gives $\frac{1}{25}$ of principal to be added yearly.

$$\begin{array}{l} £1080 \\ \underline{\quad 43{\cdot}2} \\ 1123{\cdot}2 = \text{prin. for 2nd year.} \\ \underline{\quad 44{\cdot}928} \\ 1168{\cdot}128 = \text{prin. for 3d year.} \\ \underline{\quad 46{\cdot}72512} \\ 1214{\cdot}85312 = \text{amt. for 3 yrs.} \\ \underline{\qquad\quad 20} \\ \quad 17{\cdot}0624\text{s.} \\ \underline{\qquad\quad 12} \\ \quad 0{\cdot}7488\text{d.} \end{array}$$

.. the amt. for 3 yrs. = £1214 17s. 0·7488d. Ans.

4. $82\frac{1}{2} : 140 :: 8\frac{1}{4}$s. : required price.

$\frac{33}{4}$s. $\times \frac{280}{165} = \frac{56}{4}$s. = 14s. Ans.

5. The quotation from *The Times* may be explained as follows:—When the Stock Exchange opened on the morning of the 29th November, the price of £100 in the Consolidated Funds was lower than the previous day by 2s. 6d. The £100 sold at first for £89 7s. 6d. and £89 10s.; at the close the price varied from £89 5s. to £89 7s. 6d. on the same day. The price of stock, the transfer of which was deferred till the 7th December, ranged from £87 17s. 6d. to £88; but the next half-yearly dividend, instead of being paid to the holders of this stock, was to be drawn by the sellers, *ex div.* meaning *excluding dividend.*

FEMALES.

1. The cost of insurance, etc., amounts to $£1500 \times \frac{1\frac{1}{4}}{100}$, or

$£\frac{15 \times 5}{4} = £18$ 15s.

∴ the interest on £1500 = £65 − £18 15s., or £46 5s.

$£100 = \frac{£46 \ 5\text{s.}}{15}$

i.e., £3 1s. 8d.

2. 1 butt = 108 galls. = 432 qts.

432 qts. at 5d. = 2160d.

Now ·375 of a pint = $\frac{3}{16}$ of a quart;

that is 13 parts are sold for 2160d.

∴ 3 " " " $\frac{2160 \times 3}{13}$

" " " $\frac{6480}{13}$

i.e., $498\frac{6}{13}$d., or 41s. $6\frac{6}{13}$d.

Note.—He has 3 parts of the quantity or value to himself, *i.e.*, £2 1s. $6\frac{6}{13}$d.

3. Cost price of $\frac{1}{4}$ of £25,000, at 25 p. c. profit = £6,250 × $\frac{100}{125}$ = £5,000.

Cost price of $\frac{7}{10}$ of £25,000 at $16\frac{2}{3}$ p. c. profit = £17,500 × $\frac{100}{116\frac{2}{3}}$ = £15,000.

Cost price of £1,250 at 25 p. c. loss = £1,250 × $\frac{100}{75}$ = £1,666 13s. 4d.

∴ the price of whole stock = £21,666 13s. 4d.

4. 7 cows for 13 wks. = 91 for 1 wk.

14	"	9	"	= 126	"
3	"	22	"	= 66	"
				283	"

	£	s.	d.	
$\frac{91}{283}$ of $£\frac{283}{8}$ =	11	7	6	A's
$\frac{126}{283}$ " =	15	15	0	B's
$\frac{66}{283}$ " =	8	5	0	C's

Grammar.

1. (*a*) Act a neighbour's part towards those among whom you live, so that they may both desire and feel the need of your continued stay amongst them. In order to bring this about you must act kindly, use your talents to the best advantage, and obtain an influential position. Meet men upon the common ground of human needs and human wishes, and endeavour to help them by acting up to the only happiness-giving maxim, 'It is more blessed to give than to receive.'

(*b*) *Be*—incomplete verb, *am, was, been,* imperative mood, pres. indef. tense, 2nd pers sing. agr. with subj. (*thou*).
useful—a predicative adj. qual. (*thou*).
where—rel. adv. modifying *livest.*
both—conj. corresponding with *and.*
want—trans. verb, weak conj. infin., pres. indef. gov. by *may.*
and—co-ordinating conj. connecting *want* and *wish.*
wish—trans. verb, weak conj. infin., pres. indef. gov. by *may.*
find out—compound trans. verb, weak conj. imperative, pres. indef. 2nd pers. sing. agr. with (*thou*).
men's—com. noun, plur., masc., possessive, attributive to *wants.*
wants—abstr. noun, neut., plur. obj. gov. by *find out.*

(*c*)

Sentence.	Subject.	Predicate.	Completion.	Extensions.
(a) Be useful. (Principal)	(thou)	be (*incomplete*)	useful	
(b) Where thou livest. [Adverbial to (a).]	thou	livest		where [and *connective*] (place)
(c) That they may want thy pleasing presence still. [Adverbial to (a).]	(that) they	may want	thy pleasing presence. (object)	still (time)
(d) (*That they may*) wish (*thy pleasing presence still*). [same as (c).]	(*that*) (they)	(*may*) wish	(*thy pleasing presence.*) (object)	(*still*) (*time*)

(*d*) The word *that* in the first line is used as a *subordinating conjunction* of *purpose.* This word is also a *relative pronoun* when it means either *who* or *which*, as, 'The man *that* spoke,' 'The book *that* is read'; a *demonstrative pronoun* when it stands for some thing or fact, as, 'I told him *that*,' and as a *demonstrative adjective* when it points out some expressed noun, as, 'I have heard *that* story.'

2. The classes of words in our language generally of Latin origin are *Ecclesiastical terms,* introduced by Augustine, and *miscellaneous words* brought to England through commercial relations with southern Europe, terms connected with *Feudalism, war, the chase, Legal terms, titles, terms connected with the Church,* and *domestic life,* introduced by the Normans, and latterly by the study of science and philosophy, and the almost exclusive study of classical literature in our grammar schools and universities, a great addition has been made to *scientific* and other terms.

Geography.

2. *South America.*—The Andes, perhaps the most remarkable chain in the globe for length, height and internal structure, extend from Cape Horn through the whole length of South America, by several parallel ranges of peaks supported upon a continuous plateau, to the Isthmus of Panama. For convenience the system may be divided into the *Chilian Andes, Bolivian Andes,* the *Andes of Quito,* and the *Northern Chains.* The heights in the Bolivian Andes form by far the most imposing group in the whole chain, but the highest point, *Aconcagua,* 23,910 feet, is situated in the Chilian Andes. The peaks visible from the celebrated valley of Quito are said to form an assemblage scarcely surpassed by the Bolivian Andes.

The principal river having its rise in the Andes is the *Amazon,* which is fed by tributary streams from the Northern Chains, the Andes of Quito, and the Bolivian Andes. The main stream flows east, crossing the whole breadth of the continent, and falls into the Atlantic Ocean. The *Magdalena,* with its parallel stream the *Cauca,* flows north to the Caribbean Sea, and the *Orinoco,* formed partly by tributary streams from the Andes, flows easterly into the Atlantic.

The *Brazilian system* of mountains give rise to the *Parana* and *Paraguay,* flowing south to the estuary of the *Rio-de-la-Plata,* the *San Francisco* flowing north and east to the Atlantic, the *Tocantin* and several other branches of the Amazon flowing north.

The principal mountain system of North America is the *Rocky Mountains*, which are connected by the *Plateau of Mexico*, and the *Chain of Central America* with the Andes. The Rocky Mountains give rise on the west slope to the *Rio Colorado*, flowing south to the Gulf of California, and the *Columbia River*, flowing south and west. On the eastern slope rise the *Athabasca*, continued by the *Mackenzie River* to the Northern Ocean; the *Missouri* and the other numerous branches on the right bank of the Mississippi, and the *Rio Grande* flowing south-east to the Gulf of Mexico. The *Ohio* and its tributaries on the left bank of the Mississipi rise in the *Alleghany Mountains*, which, with the *Green Mountains*, form a range parallel with the Atlantic. Close along the *Pacific Ocean* runs the almost continuous range of the *Sierra Nevada*, *Cascade Mountains*, and the *Sea Alps*.

History.

1. On the day of Richard's coronation the hatred of the mob led to a fearful massacre of the Jews in London, and in York Castle a still more hideous tragedy was enacted in the self-slaughter of five hundred Jews, after first killing their own wives and children. The Jews were hateful to the people, both because they were not Christians, and because they were usurers. They alone could lend money on interest, for the Scriptures were thought to forbid that practice to Christians, and thereby they made enormous profits. They were accused of horrible crimes, and were often subjected to great cruelties by the fierce and ignorant people among whom they lived.

2. The Stuarts were restored in 1660 by the authority of the *Convention Parliament*, which was called by the remnant of the Long Parliament "purged" out by Colonel Pride. William and Mary were placed on the throne, 1689, by the authority of the *Convention of the Estates of the Realm*, summoned by the Prince of Orange. The assembly, though equivalent to a parliament, could not be so called on account of its not being assembled by a king.

3. The chief military achievements from 1704 to 1709 were:—*Battle of Blenheim*, 1704; *Capture of Gibraltar*, 1704; *Capture of Barcelona*, 1705; *Battle of Ramillies*, 1706; *Battle of Almanza*, 1707; *Battle of Oudenarde*, 1708; *Battle of Malplaquet*, 1709; *Capture of Mons*, 1709

Louis XIV., having attempted to place his grandson, afterwards Philip V., on the Spanish throne, caused England, Holland, and the Emperor to unite in a "Grand Alliance," which was joined in by many European powers. War with France was declared, the Allies supporting the claim of the Archduke Charles of Austria to the Spanish Crown. This war is known by the name of the War of the Spanish Succession.

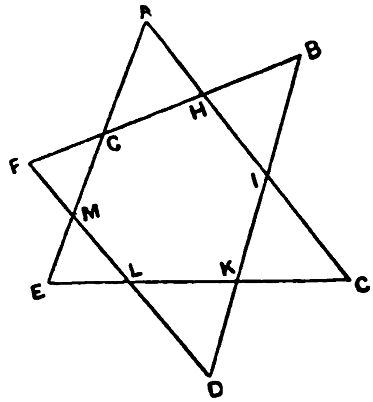
Composition.

The Navy.

To no nation in the world is the possession of a strong navy of such moment as to our own country of Great Britain. Our insular position, proximity to France (our ancient rival), our Colonial possessions, and immense wealth make us a favourite object of jealousy. The navy is our first and best line of defence, and it has been said that if we are unable to cope with the combined fleets of two or three hostile powers we shall be dependent on sufferance for our existence, and shall cease to be a first-rate power.

From early times this fact has been acknowledged, for Alfred and his successors maintained a fleet for the defence of the coasts. William I. established the Cinque Ports as the origin of a maritime force, and the great land-owners used to furnish the means of equipment and maintenance of warships. Though under the Plantagenets many naval victories were gained, yet it was not till the reign of Henry VII. that the Royal Navy had permanent existence. The *Great Harry* was followed by the building of the *Henry Grace-à-Dieu*. The attention of Elizabeth was early directed to the importance of a powerful naval force, and the patriotism of the people enabled her to equip a respectable fleet to meet the Armada. Charles I. understood the value of a navy better than his father, and therefore employed an eminent architect in constructing ships, so that Cromwell, on his accession to power, found the nucleus of a maritime force, which he raised to a grander height than it ever had reached before, and with Penn, Blake, and Lawson for admirals, it forced from the Dutch the empire of the seas. Under James II., who commanded the fleet before he became king, the royal navy was improved, both in men and material. Since that time the navy has gained victories on every sea, commanded by admirals like Howe, Jervis, Nelson, and Codrington.

Euclid.



1. Let GHIKLM be any hexagon, and let the sides of it be produced to meet in A, B, C, D, E, and F. Then ACE, FBD form two triangles cutting each other. Now the interior angles of every triangle are together equal to two right angles, therefore the angles at A, C, E, F, B, D, are together equal to four right angles because they are the interior angles of ACE, FBD, respectively.—Q.E.D.

2. Prop. v, bk. 2.
3. Prop. x., bk. 2.

Algebra.

$$1.\ \left(\frac{x^2-9x+20}{x(x-6)}\right)\left(\frac{x^2-13x+42}{x(x-5)}\right)=$$

$$\frac{(x-5x)(x-4x)(x-7)(x-6)}{x^2(x-6)(x-5)}=$$

$$\frac{(x-7)(x-4)}{x^2}=$$

$$\frac{x^2-11x+28}{x^2}=$$

$$1-\frac{11}{x}+\frac{28}{x^2}$$

2. (1) $ax \;= by$ or $x=\dfrac{by}{a}$

(2) $x+y=c$ or $x=c-y$

$$\therefore c-y=\frac{by}{a}$$

$$ac-ay=by$$

$$ac=by+ay$$

$$y=\frac{ac}{a+b}$$

By substituting $\dfrac{ac}{a+b}$ for y in (2)

$$x+\frac{ac}{a+b}=c$$

$$x=c-\frac{ac}{a+b}$$

$$x=\frac{ac+bc-ac}{a+b}=\frac{bc}{a+b}$$

2. $12x^2-x=1740$

$$x^2-\tfrac{1}{12}x=145$$

$$x^2-\tfrac{1}{12}x+\tfrac{1}{576}=\frac{145\times 576+1}{576}=\frac{83521}{576}$$

$$x-\tfrac{1}{24}=\pm\tfrac{289}{24}$$

$$x=\tfrac{1}{24}\pm\tfrac{289}{24}=\tfrac{290}{24}\text{ or }-\tfrac{288}{24}$$

$$\therefore\quad x=12\tfrac{1}{12}\text{ or }-12$$

3. If $x=$ the greater, then the less $=\dfrac{5x}{8}$

$$\therefore \tfrac{5}{8}x^2=360$$

$$5x^2=2880$$

$$x^2=576$$

$$x=\underline{24}.\text{ Ans.}$$

$$\therefore\quad y=24\times\tfrac{5}{8}$$

$$=\underline{15}.\text{ Ans.}$$

Mensuration.

1 $2\frac{1}{2}$s. = price of 1 square ft.

$\therefore \dfrac{£10}{2\frac{1}{2}\text{s.}}$ = ,, 80 square ft. = area of alcove.

Area of whole circle = 160 square ft.

$$\therefore \text{diameter} = 2\sqrt{\frac{160}{3\frac{1}{7}}} = 2\sqrt{50{\cdot}90} = 14{\cdot}27\text{ ft.}$$

and so length of semi-circular arc $= 7{\cdot}135$ ft. $\times\ 3\frac{1}{7} =$ $\underline{22{\cdot}42}$ ft. Ans.

2. Since a regular hexagon can be cut into 6 equilateral triangles, then the area of given hexagon = 15 × 15 × ·433 × 6

```
 15
 15
225
·433
 675
675
900
97·425 sq. ft. = area of one equilateral triangle.
     6
584·55 sq. ft. =        „     hexagon
```

NOTE:—·433 *is the approximate area in sq. ft. of an equilateral triangle whose side is 1 ft.*

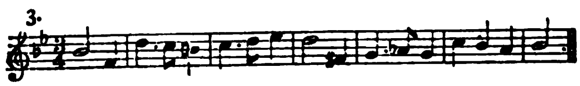
Music.

1.

2.

Diminished 4th. Diminished 7th. Augmented 2nd. Pluperfect 4th.

3.



SEPTEMBER, 1881.

CANDIDATES.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. A bankrupt's debts are £3560, and his property is worth £1349 16s. 8d. How much will his creditors lose in each pound?
2. If wheat be 6s. a bushel, what will 7 loads, 4 quarters, 3 bushels cost?
3. Find the value, in current coin, of 3 cwt. 2 qrs. 11 lbs., knowing that 27 cwt. 19 lbs. cost £37 16s. 4½d.
4. Find the value of a crop on 24 acres 3 roods and 4 poles, at £9 8s. 4d an acre.
5. If the rate of wages depends on the price of wheat, and 18 men working for 4 weeks receive £43 4s. od., when wheat is 64s. a quarter; find the price of wheat per quarter when 16 men, working for 5 weeks, obtain £67 10s. od.

FEMALES.

1 Make out the following bill:—

60½ lbs. of tea at 2½d. per oz.
78 cwt. 97 lbs. sugar at 9s. 4d. per qr.
24¾ cwt. cocoa at 1s. 4d. per lb.
18 cwt. 2 qrs. 7 lbs. rice at 2½ per lb.
376¾ lbs. coffee at 1s. 8d. per lb.

2. Find the cost of 6894½ articles at £162 8s. 2½d. each.
3. Find, by Practice, the cost of 870 miles 3 fur. 35 perches at £27 15s. per league.
4. Find, by Practice, the value of 258½ score of sheep at £2 13s. 8d. each sheep.

Grammar.

1. Parse all the nouns, verbs, and adjectives in the following:—

'All heads must come
To the cold tomb,
Only the actions of the just
Smell sweet and blossom in the dust.'

JAMES SHIRLY.

2. What are the different moods of the verb? Give two examples of verbs in the imperative, and two of verbs in the subjunctive moods.
3. Explain what is meant by active and passive verbs.

Geography.

1. What are the chief ranges of hills in the South of Scotland? Describe fully the position of each, and the courses of the rivers that rise in them.
2. Say what you know about the physical features, productions, and industrial occupations of Norfolk, Devonshire, Glamorganshire, and Kerry.
3. Describe minutely the course of a vessel sailing along the coast from Dover to Southampton, and then crossing over to visit each of the Channel Islands.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Apprehensive.*

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act.*

Music.

A quarter of an hour allowed for this paper.

1. Write over each of the following notes its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other).

2. Follow each of these notes by its corresponding rest.

3. How many tones and semitones are found in a major scale and what places therein do the latter occupy?

CANDIDATES.—ANSWERS.

Arithmetic.

MALES.

1. £3560 − £1349 16s. 8d. = £2210 3s. 4d. of loss

∴ £3560 : £1 :: £2210 3s. 4d. : loss per £1

```
         20
3560)44203(12s. 5d.
     42720
      1483
        12
     17800
     17800
```

2. 7 loads 4 qrs. 3 bush.

```
 5
39 qrs.
 8
315 bushels at 6s. = 1890s. = £94 10s. Ans.
```

3. 27 cwts. 19 lbs. = 3043 lbs.
3 cwts. 67 lbs. = 403 lbs.
£37 16s. 4½d. = 36305 farths.

∴ 3043 lbs. : 403 lbs. :: 36305 farths. : price in farths.

```
          403
        108915
       1452200
3043)14630915(4808 farths.
     12172
      24589
      24344
        24515
        24344
          171
          403
```

∴ Ans. = £5 0s. $2\frac{1}{4}\frac{171}{403}$d.

		£	s.	d.
4.	Value of 1 ac. ... ... =	9	8	4
				6
		56	10	0
				4
	Value of 24 ac. ... ... =	226	0	0
	" 2 ro. = ½ value of 1 ac. =	4	14	2
	" 1 ro. = ½ " 2 ro. =	2	7	1
	" 4 po. = $\frac{1}{10}$ " 1 ro. =	0	4	8½
	" 24 ac. 3 ro. 24 po. =	233	5	11½ Ans.

5. 16 men : 18 men }
5 wks. : 4 wks. } :: 64s. : x.
864s. : 1350s. }

64s. × $\frac{18}{16}$ × $\frac{4}{5}$ × $\frac{1350}{864}$ = 90s. Ans.

FEMALES.

		£	s.	d.
1.	60½ lbs. at 0s. 2½d. per lb. ... ... =	10	1	8
	78 cwts. 97 lbs. at 9s. 4d. per qr. ... =	147	4	4
	24¾ cwts. at 1s. 4d. per lb. .. ... =	184	16	0
	18 cwts. 2 qrs. 7 lbs. at 0s. 2½d. per lb. =	21	13	1½
	376¾ lbs. at 1s. 8d. per lb. ... ... =	31	7	11
		£395	3	0½

		£	s.	d.
2.	Value at £1 ... ... =	6894	10	0
				2
		13789	0	0
				9
		124101	0	0
				9
	" £162 ... ... =	1116909	0	0
	" 6s. 8d. = ⅓ value at £1 ... =	2298	3	4
	" 1s. 4d. = ⅕ " 6s. 8d. =	459	12	8
	" 2d. = ⅛ " 1s. 4d. =	57	9	1
	" ½d. = ¼ " 2d. =	14	7	3½
	" £162 8s. 2½d. ... ... =	£1119738	12	4½

3. £27 15s. per league = £9 5s. per mile.

		£	s.	d.
∴	Value of 1 ml. ... ... =	9	5	0
				870
	" 870 mls. ... ... =	8047	10	0
	" 2 fur. = ¼ value of 1 ml. =	2	6	3
	" 1 " = ½ " 2 fur. =	1	3	1½
	" 20 per. = ½ " 1 " =	0	11	6¾
	" 10 " = ½ " 20 per. =	0	5	9⅜
	" 5 " = ½ " 10 " =	0	2	10$\frac{11}{16}$
		£8051	19	7$\frac{5}{16}$. Ans.

4. 258½ score = 5170 sheep.

		£	s.	d.
	Value at £1 ... ... =	5170	0	0
	" £2 ... ... =	10340	0	0
	" 10s. = ½ at £1 ... =	2585	0	0
	" 3s. 4d. = ⅓ at 10s. . =	861	13	4
	" 4d. = $\frac{1}{10}$ at 3s. 4d. =	86	3	4
	" £2 13s. 8d. ... =	£13872	16	8. Ans.

Grammar.

1. *All*—indef. num. adj. qual. *heads*.
heads—com. noun, neut., plur., nom. to *must come*.
must—aux. verb, pres. indef. indic. forming with infinitive.
come—pres. indef. potential of *come, came, come*, and agrees with its subj. *heads*.
cold—adj. qual. *tomb*.
tomb—com. noun, neut. sing. obj. gov. by *to*.
actions—abstr. noun, neut. plur. nom. to *smell*.
just—adj. qual. (*persons*), used as a noun, com. plur. obj. gov. by *of*.
smell—intrans. reg. verb. indic. pres. indef. 3rd pers. plur. agr. with subj. *actions*.
sweet—adj. used adverbially.
blossom—intrans. reg. verb. indic. pres. indef. 3rd pers. plur. agr. with subj. *actions*.
dust—com. noun, neut. sing. obj. by *in*.

2. The different moods of the verb are :—*Indicative, Potential, Subjunctive, Imperative*, and *Infinitive*. *Do* this, *write* these words ; I fear lest he *come*, I care not though he *die*, *Do*, *write* are examples of the *Imperative*, and *come*, *die* of the *Subjunctive mood*.

3. Verbs are said to be *Active* when the subject *acts*, and *Passive* when the subject is *acted* upon ; as, The boy *strikes* (active) the table. The table *is struck* (passive). The passive is merely used as a change of form, and only verbs which take an object can properly be changed into the passive, the *object* in the *active voice* becoming the *subject* in the *passive*.

Geography.

1. The chief hills in the south of Scotland are the *Cheviots*, forming a natural boundary between England and Scotland, giving rise to several affluents of the Tweed flowing N., the *Moffat*, and *Lowther*, and *Lead Hills*, in the N. of Dumfries-shire, from which flow the *Liddell*, *Esk*, and *Annan*, S. to the Solway, the *Clyde* N.W. through Lanark, and the *Tweed* N. and E. through Peebles, Selkirk, Roxburgh, and between Berwick and Northumberland ; the Ayrshire Hills take a crescent-like form, enclosing the county, and give rise to the *Nith* flowing S. to the Solway, and the *Ayr* and *Irvine* flowing W., the *Doon* flowing N.W., the *Stinchar* and the *Girvan* flowing S.W. all into the Firth of Clyde. The *Lammermuirs* and the *Moorfoot Hills*, the former between Haddington and Berwick, and the latter mostly in Mid-Lothian, give rise to several small branches of the Tweed flowing south, and the *Tyne*, in Haddington, flowing easterly.

2. *Norfolk*.—The greater part of the county is occupied by the East Anglian heights, which overlook a strip of the Fens included within the limits of Norfolk, and through which flows the Great Ouse. The chief of the other rivers are the *Bure*, the *Yare*, and the *Waveney*, having the same opening into the sea at Yarmouth. The industries are agriculture, shipping-trade, and fisheries, with some small manufactures of silk crape and baize.

Devonshire stretches across from the Bristol to the English Channel, and naturally divides itself into these three parts—(1) *Exmoor* in the N., (2) *Dartmoor* in the S., and (3) a broad plain of pasture land between them. The first two are wild tracts, while the last is beautiful and fertile. The county is mainly *agricultural* and *mining*, but some shipbuilding is carried on at the various ports. Devon is noted for *cider*, and its *butter* is the best in the world. The rivers are the *Exe*, *Tawe*, *Tamar*, *Dart*, *Axe*, *Torridge*, and *Teign*.

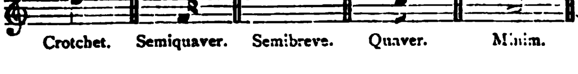
Glamorganshire occupies the most southern part of Wales. It is wild and mountainous in the N., but level and fertile towards the S. The "Vale of Glamorgan" has been styled the "Garden of Wales." The principal rivers are the *Taff*, the *Tawe*, *Avon*, and *Neath*. It is eminently a mining and manufacturing county. *Coal* and *iron* are abundant, and by means of these minerals it has become a great centre of iron-smelting and manufacturing trades.

Kerry is a county in the S.W. of Ireland. Its surface is chiefly formed of mountain ranges, in which are Macgillicuddy's Reeks, with Carntual (3404 ft.), the highest summit in Ireland. Its rivers are unimportant, but its lakes comprise those of Killarney, famed for picturesque scenery. The coast is deeply indented with the Bays of *Tralee*, *Dingle*, and *Kenmare*. Off the coast is *Valentia*, a terminus of the Atlantic telegraph cables. The county is rich in minerals ; but dairy-farming is the leading industry.

3. Leaving the thriving town of *Dover*, which has a great passenger traffic with *Calais*, we pass *Folkestone*, the neat bathing-town of *Hastings*, Brighton, a beautiful town, the favourite resort of George IV., and lying to the west of *Beachy Head* and *Newhaven*, which trades with *Dieppe*. Continuing westerly along the coast of Sussex, we round *Selsea Bill* and come to the safe anchorage of *Spithead*, noting the strongly fortified naval station of *Portsmouth*. After a run up to visit the packet station of *Southampton*, we turn south, passing through the *Solent*, N.W. of the Isle of Wight, and voyage still southwards to the Channel Islands, which, including *Jersey*, *Guernsey*, *Alderney*, and *Sark*, are all that remain of our Norman possessions. Alderney is noted for its cows. *St. Helier* is the capital of Jersey, and St. Peter's Port of Guernsey. These islands are officially included in the county of Hampshire.

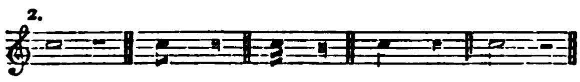
Music.

1. D. F. G. C. A.



Crotchet. Semiquaver. Semibreve. Quaver. Minim.

2.



3. Five tones and two semitones, the latter being found between the third and fourth, and seventh and eighth notes of the scale.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. Find the cost of $6\frac{19}{40}$ tons of hay at the rate of £$3\frac{11}{32}$ for a ton and a quarter.
2. What sum of money is the same fraction of £7 that $\frac{3}{8}$ of 5s. is of 17s. 6d.?
3. Find the quotient to 5 places of decimals, of 17 · 171717 divided by the product of 19·85 multiplied by 17·3.
4. What decimal fraction is equal in value to $\frac{25\frac{3}{4}}{3535\frac{5}{7}}$?
5. Out of £$4\frac{3}{8}$ one third is paid to A., and one seventh to B. After this, $\frac{4}{11}$ of the remainder is paid to A., and the rest to B. Find the sums received respectively by A. and B.

FEMALES.

1. A bankrupt owes £7065, but he can only pay 7s. 6d. in the pound; what amount of money will he leave unpaid?
2. If goods are carried 809 miles for £6 14s., how far could th y be carried for £91 19s. 9d. at the same rate?
3. If 32 men mow 96 acres of grass in 8 days, how many men must be employed to mow a square mile in 20 days?
4. If 12 yds. of silk, 18 inches wide cost £3 12s, what will be the cost of $13\frac{1}{2}$ yds. of the same quality silk 21 inches wide?

Grammar.

1. Parse the pronouns and prepositions in the following:—

> 'With joy unfeign'd brothers and sisters meet,
> An' each for other's welfare kindly spiers:
> Each tells the uncos that he sees or hears;
> The parents, partial, eye their hopeful years.'
>
> BURNS.

2. Name the interrogative pronouns, and state which of them are used both substantively and adjectively, and which only substantively; give examples.
3. Of prepositions some are simple; some compound, or derivative. Give examples of each; and, if you can, show from what words the compound prepositions are made up.

Geography.

Answer either Q. 2, *or* Q. 3; not both.

1. Draw a map of Scotland to the South of the Firths of Forth and Clyde, showing the chief ranges of hills, the courses of the principal rivers, the coast line, and chief towns.
2. Name the chief rivers which rise in the Alps; and describe their courses.
3. Name the chief seaports on the Mediterranean, and say what you know about each of them.

History.

1. Write down the names and dates of our kings from Canute to William I.
2. How many kings named Henry have sat on the throne? Give their dates and mention their immediate successors.
3. Make a list of our sovereigns from 1702 to the present time, with the dates of their accession.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Apprehensive.*

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act.*

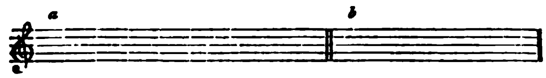
Composition.

Write from memory the substance of the passage read to you by the Inspector.

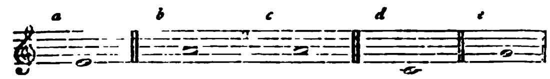
Music.

A quarter of an hour allowed for this paper.

1. Write in *a* the scale of G (*Sol*), and in *b* the scale of F (*Fa*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.



2. Place its second over *a*, its third over *b*, its fourth over *c*, its fifth over *d*, and its octave over *e*.



3. How many semiquavers are equal (in length) to one minim?

How many quavers are equal (in length) to one dotted minim?

How many crotchets are equal (in length) to one semibreve?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1 $1\frac{1}{4}$ tons $=\frac{5}{4}$ tons; $6\frac{19}{40}$ tons $=\frac{259}{40}$ tons; £$3\frac{11}{32}=$ £$\frac{107}{32}$.

$\therefore \frac{5}{4} : \frac{259}{40} :: $ £$\frac{107}{32} : x$.

£$\frac{107}{32}\times\frac{259}{40}\times\frac{4}{5}=$ £$\frac{5957}{320}=\frac{3}{4}$d. $\times 5957=$

$\frac{17871}{4}$d. $=4467\frac{3}{4}$d. $=372$s. $3\frac{3}{4}$d. $=$

£18 12s. $3\frac{3}{4}$d. Ans.

2. $\frac{\frac{3}{8}\text{ of 5s.}}{17\frac{1}{2}\text{s.}}=\frac{15}{140}=\frac{3}{28}$. Now the question is, what sum is $\frac{3}{28}$ of £7?

$\frac{3}{28}$ of £$7=$ £$\frac{3\times7}{28}=$ £$\frac{3}{4}$ or 15s. Ans.

3.

```
   19·85
   17·3
  ------
   59 55
  138 95
  198 5
  ------
 343·405)  17·171717  (·05000+
           17 17025
           ---------
              146717
```

4. $\frac{25\frac{3}{4}}{3535\frac{5}{7}}=\frac{\frac{103}{4}}{\frac{24750}{7}}=\frac{721}{99000}=\frac{\cdot721}{99}=\cdot00728$. Ans.

5. $\frac{1}{3}+\frac{1}{7}=\frac{7+3}{21}=\frac{10}{21}$; $\frac{4}{11}$ of the rem. $\frac{11}{21}=\frac{4}{21}$; $\frac{11}{21}-\frac{4}{21}=\frac{7}{21}$.

			£	s.	d.	
∴ A gets $\frac{1}{3}+\frac{4}{21}$ or $\frac{11}{21}$	of £4 7s. 6d.	=	2	5	10	A's.
B ,, $\frac{1}{7}+\frac{7}{21}$ or $\frac{10}{21}$	,,	=	2	1	8	B's. Ans

FEMALES.

1. Since only 7s. 6d. is paid, 12s. 6d. must be unpaid on every £; ∴ $12\frac{1}{2}$s. × 7065 = 88312s. 6d. = £4415 12s. 6d. Ans.

2. £6 14s. = 134s. = 1608d.

£91 19s. 9d. = 1839s. 9d. = 22077d.

∴ 1608d. : 22077d. :: 809 miles : x miles.

$\frac{809\text{ mls.}\times 22077}{1608}=\frac{809\times 7359}{536}=\frac{5953431}{536}=$

$11107\frac{79}{536}$ mls. Ans.

3. $\left.\begin{matrix}96\text{ ac.} : 640\text{ ac.}\\ 20\text{ days} : 8\text{ days}\end{matrix}\right\} :: 32\text{ men} : x\text{ men}.$

$\frac{32\text{ men}\times 640\times 8}{96\times 20}=\frac{256}{3}=85\frac{1}{3}$ men. Ans. (The $\frac{1}{3}$ may be explained as one who can do the third part of a man's work.)

4. $\left.\begin{array}{l}48\text{ qrs.} : 53\text{ grs.}\\ 18\text{ in.} : 21\text{ in.}\end{array}\right\} :: £3\ 12\text{s.} : x.$

$\frac{72\text{s.} \times 53 \times 21}{48 \times 18} = \frac{371}{4}\text{s.} = \underline{£4\ 12\text{s.}\ 9\text{d.}}$ Ans.

Grammar.

1. *each*—distrib. adj., pron. com. sing., nom. to *spiers*.
other's—indef. adj., pron. com., sing. poss., qual. *welfare*.
each—*same as before* mas., nom. to *tells*.
that—simple rel. pron., neut. plur., standing for *uncos*., obj. gov. by *sees* or *hears*.
he—3rd pers. pron., mas., sing., nom. to *sees* or *hears*.
their—pronom. poss. adj. (or poss. of *they*), qual. *years*.
with—prep. gov. obj. case *joy*.
for— „ „ „ *welfare*.

2. The interrogative pronouns are *who, which, what, and whether*. *Which* and *what* are used both substantively and adjectively, as, *which* (adj.) dress do you prefer? I know not *which* (subs.) is *which*. *What* (subs.) is sweeter than honey? *What* (adj.) towns are in Devon? *Who* is used only substantively, as, *Who* are you? *Whether* is now rarely used as a pronoun, but it occurs in earlier English, as, Whether of them twain did the will of his father?

3. Simple prepositions are—*at, by, down, for, from, in, of.* Compound, or derivative prepositions are—*abaft* (à-be-æftan), *above* (á-be-úfan), *before* (bi-foran), *beside* (= by side), *between* (= by two), *across* (French croix).

Geography.

2. The chief rivers which rise in the Alps are the *Rhine*, the *Rhone*, and the *Po*.

The *Rhine* rises in Mt. St. Gothard, passes through L. Constance, divides Switzerland from Germany, flows through the German States till, passing into Holland, it separates into two branches, and falls by several mouths into the North Sea. It is the most picturesque river of Europe. The *Rhone* rises in Switzerland about five miles from the source of the Rhine, and enters L. Geneva, from which it issues to flow west to the city of Lyons in France. It then turns south and enters the Mediterranean by four months. It is the most rapid river in Europe. The *Po* issues from Mt. Viso in the Cottian Alps, and traversing the plains of Piedmont and Lombardy from west to east, flows by several mouths into the Adriatic.

3. Beginning at the Spanish coast, we find *Barcelona*, the second city of Spain, with important manufactures and exports of iron, cork, and fruits. *Marseilles*, the first port in France, has immense trade with Algiers. *Toulon* has been termed the 'Brest of the Mediterranean' and the 'Plymouth of France.' *Leghorn* is the chief port of Italy with a fine harbour; exports silks, straw hats, &c. *Brindisi*, on the south-east coast of Italy, is the nearest sea-port to Alexandria on the European system of railways. *Ancona* on the Adriatic and *Venice*, with its numerous canals and hundred islands, are great entrepôts for European goods. *Trieste* is the chief port in Austria. *Smyrna*, on the coast of Asia Minor, is the principal port in the Levant *Alexandria*, the chief port of Egypt, is one of the stations on the 'Overland Route.'

History.

				A.D.
1.	Canute	began to	reign	1017
	Harold	„	„	1035
	Hardicanute	„	„	1040
	Edward (the Confessor)	„	„	1042
	Harold II.	„	„	1066
	William I. (the Conquerer)	„		1066

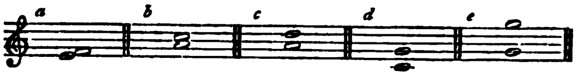
2. Eight kings of the name of Henry have sat on the throne, namely:—

		A.D.			A.D.
Henry I.	began to reign	1100;	suc. by	Stephen	1135
Henry II.	„	1154;	„	Richard I.	1189
Henry III.	„	1216;	„	Edward I.	1272
Henry IV.	„	1399;	„	Henry V.	1413
Henry V.	„	1413;	„	Henry VI.	1422
Henry VI.	„	1422;	„	Edward IV.	1461
Henry VII.	„	1485;	„	Henry VIII.	1509
Henry VIII.	„	1509;	„	Edward VI.	1547

				A.D.
3.	Anne	began to	reign	1702
	George I.	„	„	1714
	George II.	„	„	1727
	George III.	„	„	1760
	George IV.	„	„	1820
	William IV.	„	„	1830
	Victoria	„	„	1837

Music.

1.


2.


3. Eight.
Six.
Four.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a-half allowed.

Arithmetic.

Males.

1. Find simple interest on £976 10s. 0d for a year and a quarter at $3\frac{1}{2}$ per cent. per annum.

2. A barrel of beer (36 gals.) lost by leakage 8 per cent. How many pints of beer were left in the cask?

3. A sum of money was lent on the 10th of September, and by the 2nd of November the interest, at $4\frac{3}{4}$ per cent. per annum, amounted to £1 0s. 8[illegible]d. What was the sum lent?

4. If, in 2 years and 63 days, the simple interest on £325 is £24 14s. 3[illegible]d., what is the rate per cent. per annum?

5. If an Exchequer bill for £1000 bears interest at the rate of 2s. a day, what is the interest per cent. per annum on the bill?

Females.

1. Reduce to the least common denominator $\frac{4}{7}$, $\frac{3}{10}$, $\frac{5}{12}$, $\frac{17}{35}$, $\frac{4}{63}$, $\frac{11}{28}$.

2. Multiply the sum of $3\frac{3}{8}$, $4\frac{3}{4}$, and $4\frac{1}{8}$, by the difference of $7\frac{2}{7}$ and $5\frac{1}{8}$; and divide the product by the sum of $94\frac{1}{8}$ and $4\frac{1}{2}$.

3. If a yard of lace cost £1[illegible], what will 16[illegible] yards cost?

4. If $\frac{3}{8}$ of a ship be worth £3740, what is the value of the whole?

Grammar.

1. 'The merry part of *mankind* are very *amiable*, whilst they diffuse a cheerfulness *through* conversation at proper seasons; but *on the contrary*, they are a *great grievance* to society when they infect every discourse with insipid mirth, and turn into ridicule *such* subjects *as* are not *suited* to it.'

Addison.

(*a*.) Point out the conjunctions in the above, and say to which class of conjunctions each belongs.
(*b*.) Parse the words in italics.
(*c*.) Analyse the adverbial and adjectival sentences in the above.

2. Show, by examples, that the words *since*, *but*, and *except* may be sometimes conjunctions and sometimes prepositions.

Geography.

Answer *either* Q. 1, *or* Q. 3; *not both*.

1. Name the chief rivers which rise in the Alps, and describe their courses.

2. Draw a full map of our possessions in South Africa and the countries bordering on them.

3. Give notes of a lesson on 'the physical features, climate, productions, inhabitants, and history of Jamaica.'

One hour allowed for Females.
Two hours and a-half allowed for Males.

History.

1. How came a Roman Emperor to be proclaimed in York A.D. 306? Who was he, and how connected with Britain?

2. Who was Canute? Into what earldoms did he divide this kingdom?

3. In the 13th century what part was taken by Cardinal Langton in securing English freedom?

Penmanship.

Write, in large hand, as a specimen of copy setting, the word *Apprehensive.*

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act.*

Composition.

Write full notes of a lesson on *Timber Trees.*

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. Define *straight line, plane superficies, obtuse angle, circle, regular polygon, parallel straight lines, axiom.*

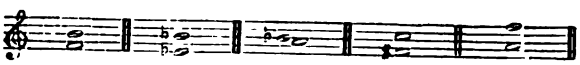
2. If two angles of a triangle be equal to each other, the sides also which subtend, or are opposite to, the equal angles, shall be equal to one another.

3. If two triangles have two sides of the one equal to two sides of the other, each to each, but the angle contained by the two sides of one of them greater than the angle contained by the two sides equal to them, of the other; the base of that which has the greater angle shall be greater than the base of the other.

Music.

A quarter of an hour allowed for this paper.

1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms.



2. Write in *a* two measures of common time, and in *b* two measures of triple time.

3. Write in *a* the signature of F (*Fa*), in *b* that of E♭ (*Me*), in *c* that of G (*Sol*), and in *d* that of A (*La*).

ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. $£976\frac{1}{2}\times 1\frac{1}{4}\times\frac{3\frac{1}{2}}{100}=£\frac{1953\times 5\times 7}{2\times 4\times 200}=£\frac{19{\cdot}53\times 35}{16}=$

$£\frac{683{\cdot}55}{16}=£\frac{683\ 11s.\ 0d.}{4\times 4}=\underline{£42\ 14s.\ 5\frac{1}{4}d.}$ Ans.

2. 36 galls. $=36\times 8$ or 288 pts.; and since by losing 8 per cent., 92 pts. are left out of every 100,

i.e., $\frac{92}{100}\ \therefore\ \frac{288\times 92}{100}=\underline{264\frac{24}{25}\text{ pts.}}$ Ans.

3. (*a*) The number of days from 10th Sept. till 2nd Nov. $=$
$20+31+2=53$

(*b*) $£1\ 0s.\ 8\frac{22}{73}=248\frac{22}{73}=\frac{18126}{73}d.$

(*c*) $£4\frac{3}{4}\qquad =1140d.$

$\therefore \left.\begin{array}{l}53\text{ das.} : 365\text{ das.}\\ 1140d. : \frac{18126}{73}d.\end{array}\right\} :: £100 : \text{sum required.}$

$£100\times\frac{365}{53}\times\frac{18126}{1140\times 73}=25\times 6=\underline{£150.}$ Ans.

4. (*a*) 2 yrs. 63 das. $=$ 793 days.

(*b*) $£24\ 14s.\ 3\frac{15}{73}d.=5931\frac{15}{73}d.=\frac{432978}{73}d.$

$\therefore \left.\begin{array}{l}793\text{ days} : 365\text{ days}\\ £325\quad : £100\end{array}\right\} :: \frac{432978}{73} : \text{rate in pence,}$

$\frac{432978}{73}d.\times\frac{365}{793}\times\frac{100}{325}=840d.=\underline{£3\ 10s.}$ Ans.

5. $\left.\begin{array}{l}1\text{ day} : 365\text{ days}\\ £1000 : £100\end{array}\right\} :: 2s. : \text{interest p.c. in s.}$

$2s.\times\frac{365\times 100}{1000}=73s.\quad \underline{£3\ 13s.}$ Ans.

FEMALES.

1. $\frac{4}{7},\ \frac{3}{10},\ \frac{5}{12},\ \frac{17}{35},\ \frac{4}{63},\ \frac{15}{28}$ have for L.C.D. 1260, and when reduced to same denominator $=$

$\frac{360,\ 378,\ 525,\ 612,\ 80,\ 675}{1260}.$ Ans.

2. (*a*) $3\frac{2}{3}+4\frac{3}{4}+4\frac{4}{5}=11\frac{40+45+48}{60}=13\frac{13}{60}$ or $\frac{793}{60}$.

(*b*) $7\frac{6}{7}-5\frac{5}{6}=7\frac{36}{42}-5\frac{35}{42}=2\frac{1}{42}$ or $\frac{85}{42}$

(*c*) $94\frac{1}{3}+4\frac{1}{3}=98\frac{2}{3}=\frac{296}{3}$.

(*d*) Product of (*a*) and (*b*) divided by (*c*) $=$

$\frac{793}{60}\times\frac{85}{42}\times\frac{3}{789}=\frac{793\times 17\times 1}{3\times 21\times 789}=\underline{\frac{13481}{49707}}.$ Ans.

3. $£1\frac{29}{96}\times 16\frac{11}{25}=£\frac{125\times 411}{96\times 25}=£\frac{685}{32}=\underline{£21s.\ 8s.\ 1\frac{1}{2}d.}$ Ans.

4. The whole will be $£3740\times\frac{8}{3}=£\frac{29920}{3}=\underline{£9973\ 6s.}\ 8d.$

Grammar.

1. (*a*) *whilst*—a subordinative temporal conjunction.
but—co-ordinative adversative „
when subordinative temporal „
and—simple co-ordinative „

(*b*) *mankind*—com. collective noun, plur., masc., obj. gov. by *of.*
amiable—adj., qual. *part.*
through—prep. gov. obj. case *conversation.*
on the contrary—adverbial phrase used independently.
grievance—abstr. noun, neut. sing. in opposition with *they.*
such—indef. adj., qual. subjects.
as—conj. = relative neut., plur., relative to *subjects*, nom. to are.
suited—complete part. of the reg. verb *suit*, qual. subjects.

Kind of Sent	Connective.	Subject.	Predicate.	Object:	Extensions.
(*a*) Adverbial	whilst	they	diffuse	a cheerfulness	1. through conversation 2. at proper seasons
(*b*) Adverbial	when	they	infect	every discourse	with insipid mirth.
(*c*) Adjective		as = which	are not suited to it		

2. Prepositions:—He has been in London *since* Monday.
They were all lost *but* one.
We are all here *except* Tom.
Conjunctions:—Let us begin *since* he has not arrived.
They are often amiable, *but* sometimes they are disagreeable.
Except ye repent, ye shall all likewise perish.

Geography.

1. *See same question answered under First Year in this number of Magazine.*

3. JAMAICA. — *Physical Features.* — Surface very uneven, eastern part almost entirely filled with the *Blue Mts.*, which have many spurs. Western boundary of this mountain region formed by a *ridge* running across the whole island from S.E. to N.W. Greatest plain in the island called *Liguanea. Plain of Vere*, another level tract separated from the former by a low range of hills, numerous valleys, but all very narrow. Limestone caverns occur. Jamaica is well watered with rivers, rivulets, and springs. None of the rivers navigable except the *Black River.*

Climate exceedingly hot on lower plains along the southern coast. Two rainy and two dry seasons. Earthquakes frequent, hurricanes less frequent than in the other West India islands.

Productions.—Staple articles of export—sugar, coffee, pimento, maize, tobacco, cinchona cultivated since 1867. All kinds of tropical products.

Inhabitants.—Africans and their descendants, Coolies, and Europeans—at present about thirty-two blacks to every white—half a million in all.

History.—Discovered by Columbus 1494—possessed by Spain till 1655—captured by the English—conspiracy of slaves 1745—revolt of Maroons 1795—another negro insurrection 1865. After that year it became a crown colony.

History.

1. Constantius having gone to Britain to quell a disturbance between two "Counts of the Saxon shore," was the last emperor to reside in the country. He died at York (306), where his son Constantine assumed the title of Cæsar. Constantine is believed to have had a share of British blood through his mother Helena.

2. Canute the Dane was the son of Sweyn who conquered the kingdom from Ethelred the Unready. Canute, by a vote of the States convened at London, was appointed to the vacant throne 1017, after the death of Edmund Ironside, with whom he had shared the kingdom. By Canute the country was divided into four earldoms—*Northumberland*, *Mercia*, *East Anglia*, and *Wessex*.

3. In the reign of King John, Stephen Langton stood forth as the champion against the Crown of the liberties of all sorts and conditions of men. To Langton, along with Marshal, Earl of Pembroke, are we indebted most deeply for the privileges which for so many centuries we have possessed. The list of demands agreed on by the barons was embodied in the Great Charter signed by King John at Runnymead (1215).

Composition.

Definition.—Timber-trees are those which can be cut into great planks of wood; some trees grown for their timber, others for their beauty or fruit.

Kinds of Native Timber-trees.—Oak, elm, beech, ash, and fir, are the common English timber-trees.

Oak.—One of our largest and most useful trees—thick trunk—rough bark—green irregular leaves—massive branches—seeds called acorns, on which pigs and squirrels feed—of slow growth—attains full size in about 100 years—bark used for tanning—wood for shipbuilding, pulpits, pews, carved work; even the sawdust used by the dyer.

Elm.—Next to the oak for beauty—grows to great height—leaves of a beautiful glossy green during early spring—generally grown to form avenues—wood suited for water-wheels, bottoms of ships, large stakes for embankments, carving—the leaves are food for cattle.

Beech.—A noble-looking tree—rounded leaves—smooth mottled bark—large knotted roots—large woods of it in several parts of the country—fruit called *beech mast*, food for deer, squirrels, and pigs—wood very durable, used by the turner for washing bowls, bed-posts, large screws, and all kinds of furniture.

Ash.—A large tree, but not so bushy as elm or beech—smooth bark—light coloured leaves which come late in spring and fall early—seeds winged—wood strong and tough, used for plough handles, shafts of pickaxes, etc., spokes of wheels for waggons, carts, and agricultural implements.

Fir.—The most generally useful of all the timber-trees—often forms extensive forests—grows in the bleakest and most exposed situations—leaves like spikes and ever-green, of a feathery appearance—seeds packed in cones in hundreds. Scotch fir or wild pine gives us the wood known as *deal*—very easily worked—made into joists, floors, stair-cases, window-frames, doors, shelves—trees sawn into planks, where felled, by water-mills—firs usually grow tall, and are thus well adapted for masts of ships. Turpentine flows from firs in the form of juice, which is collected in troughs and put into casks. Pitch and tar also got from the fir.

Euclid.

1. A *straight line* is that which lies evenly between its extreme points.

A *plane superficies* is that in which, any two points being taken, the straight line between them lies wholly in that superficies.

An *obtuse angle* is that which is greater than a right angle.

A *circle* is a plane figure contained by one line which is called the circumference, and is such that all straight lines drawn from a certain point (called the *centre*) within the figure to the circumference are equal to one another.

A *regular polygon* is a rectilineal figure contained by more than four equal straight lines.

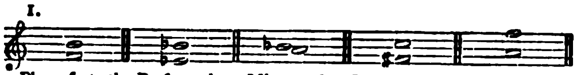
Parallel straight lines are such as are in the same plane, and which being produced ever so far both ways do not meet.

An *axiom* is a proposition so simple that the truth of it is admitted without proof.

2. Prop. 6, Book 1.
3. Prop. 24, Book 1.

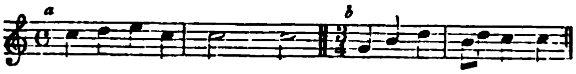
Music.

1.



Pluperfect 4th. Perfect 5th. Minor 2nd. Imperfect 5th. Minor 6th.

2.



3.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May,* 1878; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a-half allowed.

Arithmetic.

MALES.

1. How much tea at 4s. 9d. a lb. must I give for a cwt. and a quarter of sugar at 9½d. a lb. in order to gain 5 per cent. by the exchange?

2. If an oz. of wrought silver be worth 5s., what percentage of 1 lb. Troy should be the weight of a cup for which I am asked to pay £2 16s. 6⅜d.?

3. If by laying out £2,490 in 3½ per cents. I can get an income of £96 16s. 8d. per annum, what is the price of the stock per cent.?

4. If £3,500 were invested in 3½ per cents. at 98, what income would be derived from the investment per month, supposing interest to be paid monthly?

5. The standard silver coin of this realm is made of a metal of which 92·5 per cent. is pure silver and the rest alloy. Out of 1 lb. Troy of this mixed metal are coined 66s. What then is the value at the Mint of an oz. of standard silver, and what of an oz. of pure silver, and what quantity of alloy is there in a 5s. piece?

FEMALES.

1. If 10 cannon, which fire 3 rounds in 5 minutes, kill 270 men in 1½ hours, how many cannon, which fire 5 rounds in 6 minutes, will kill 500 men in 1 hour at the same rate?

2. What are the values of ·203125 qrs., and ·73625 bush. of corn?

3. Express 12s. 6¾d., 15s. 9¾d., and £4 13s. 4½d. as decimals of £1.

4. Required the exact value of ·75 of 6s. 8d. — 1·84375 of 4s. + 3·9796 of 2s.

Grammar.

1. What is the derivation of the word *transitive*, and how is that derivation connected with the use of the words *transitive*, *intransitive*, in grammar?

2. 'When I came to my castle I fled into it *like one pursued*: whether I went over by the ladder or *went* in at the hole which I called a door, I cannot remember; *no*, *nor could I remember the next morning;* for never frighted hare fled to cover, or fox to earth, with more terror of mind *than I* to this retreat.'

DEFOE.

(*a*.) Analyse the above passage from '*when I came*' to '*next morning*.'

(*b*.) Parse the words in italics.

Geography.

1. Draw a full map of our possessions in South Africa and the countries bordering on them.

2. Give full notes of a lesson on 'The River Jordan.'

One hour allowed for Females, two hours and a half for Males.

History.

1. Who was the mother of Henry VII. and what title did he bear before he ascended the throne?

2. There have been four Queens Regnant in England; give their names, parentage, and dates, and sketch the character of one of them.

3. What led to the declaration of American Independence in 1776?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Apprehensive*.

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act*.

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid

[All generally understood abbreviations for *words* may be used, but symbols of *operation*, such as $-$, $+$, $\times$, are not admissible.]

1. Straight lines which are parallel to the same straight line are parallel to each other.
2. Describe a parallelogram equal to a given square, and having an angle equal to half a right angle.
3. Equal triangles upon equal bases in the same straight line, and towards the same parts, are between the same parallels.

Algebra.

1. Multiply $-2xy+4x^2-y^2$ by $3y^2-2xy+4x^2$, and divide $-91a^3b^3x^3$ by $-13b^3x^3$.
2. Reduce to lowest terms $\dfrac{85(20a^4+a^3-1)}{102(25a^4+5a^3-a-1)}$
3. Solve the equations :—

$$(1.)\quad -\cdot 1x+\frac{x-7\cdot 655}{\cdot 23}=\cdot 7.$$

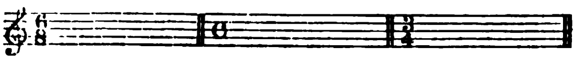
$$(2.)\quad \frac{x-3}{x-2}+\frac{x-4}{x-3}=2.$$

Music.

A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of F (*Fa*). Mark the places of the semitones.

2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures.



3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature.

ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. $\left.\begin{array}{rl} 57\text{d.} : & 9\tfrac{1}{2}\text{d.} \\ 105 : & 100 \end{array}\right\} :: 140 \text{ lbs.} : x \text{ lbs. tea}$

$140 \text{ lbs.} \times \frac{19}{114} \times \frac{100}{105} = \frac{200}{9} = \underline{22\tfrac{2}{9} \text{ lbs.}}$ Ans.

2. £2 16s. $6\frac{3}{8}$d. $= \frac{5427}{8}$d. which divided by 60d. will give the No. of ozs. required, *i.e.* $\frac{5427}{480}$ oz. and this fraction represented as the percentage of 1 lb. or 12 ozs. Troy $=$ $\frac{5427}{480} \times \frac{100}{12}$ or $\underline{94\tfrac{7}{32}}$. Ans.

3. £$96\frac{5}{8}$: £$3\frac{3}{8}$ :: £2490 : price of £100 stock

£$2490 \times \frac{3}{8} \times \frac{8}{83} = \underline{£90.}$ Ans.

4. $\left.\begin{array}{rl} £98 : & £3500 \\ 12 \text{ mos.} : & 1 \text{ mo.} \end{array}\right\} :: £3\tfrac{1}{2} : \text{monthly income}$

£$\frac{7}{2} \times \frac{3500}{98} \times \frac{1}{12} = \underline{£10\ 8\text{s.}\ 4\text{d.}}$ Ans.

5. (*a*) 12 oz. of standard silver = 66s.

∴ 1 „ „ „ = $\underline{5\text{s. } 6\text{d.}}$

(*b*) Now since $\frac{92\cdot 5}{100}$ or $\frac{37}{40}$ of an oz. of pure silver = 5s. 6d. (not reckoning alloy) ∴ the value of the whole oz., will be 5s. 6d. $\times \frac{40}{37}$ or $\underline{5\text{s. } 11\tfrac{13}{37}\text{d.}}$

(*c*) And since there are $\frac{3}{40}$ of an oz. of alloy, or 18 dwts. in $5\frac{1}{2}$s., then in a 5s. piece there must be 18 dwts. $\times \frac{5}{5\frac{1}{2}}$ or

$$\frac{18 \times 10}{11} = \underline{16\tfrac{4}{11} \text{ dwts.}} \quad \text{Ans.}$$

FEMALES.

1. $\left.\begin{array}{rl} 5 \text{ rounds} : & 3 \text{ rounds} \\ 5 \text{ min.} : & 6 \text{ min.} \\ 270 \text{ men} : & 500 \text{ men} \\ 1 \text{ ho.} : & 1\tfrac{1}{2} \text{ ho.} \end{array}\right\} :: 10 \text{ cannon} : x \text{ cannon,}$

$10 \text{ cannon} \times \frac{3}{5} \times \frac{6}{5} \times \frac{500}{270} \times \frac{3}{2} = \underline{20 \text{ cannon.}}$ Ans.

2. (*a*)

$$\begin{array}{ll} \cdot 203125 & \text{qrs.} \\ \underline{\qquad\quad 8} & \\ 1.625 & \text{bush.} \\ \underline{\qquad 4} & \\ 2\cdot 5 & \text{pks.} \end{array}$$

$\underline{1 \text{ bush. } 2\tfrac{1}{2} \text{ pks.}}$ Ans.

(*b*)

$$\begin{array}{ll} \cdot 73625 & \text{bush.} \\ \underline{\qquad\quad 4} & \\ 2.945 & \text{pks.} \end{array}$$

$\underline{2\tfrac{189}{200} \text{ pks.}}$ Ans.

3. (*a*)

$$\begin{array}{r|l} 12 & 6\cdot 75\text{d.} \\ 20 & 12\cdot 5625\text{s.} \\ & \underline{£\cdot 628125} \end{array}$$

(*b*)

$$\begin{array}{r|l} 12 & 9\cdot 75\text{d.} \\ 20 & 15\cdot 8125\text{s.} \\ & \underline{£\cdot 790625} \end{array}$$

(*c*)

$$\begin{array}{r|l} 12 & 4\cdot 5\text{d.} \\ 20 & 13\cdot 375\text{s.} \\ & \underline{£4\cdot 66875} \end{array}$$

4.

$$\begin{array}{lrl} & & \text{shillings.} \\ \cdot 75 \text{ of 6s. 8d.} = \tfrac{3}{4} \text{ of } 6\cdot\dot{6}\text{s.} & = & 5\cdot 0000 \\ +\ 3\cdot 9796 \text{ of 2s.} & = & +\ \underline{7\cdot 9593\tfrac{1}{3}} \\ & & 12\cdot 9593 \\ -\ 1\cdot 84375 \text{ of 4s.} & = & -\ \underline{7\cdot 375} \\ & & 5\cdot 5843\tfrac{1}{3}\text{s.} \\ & & \underline{\qquad 12} \\ & & 7\cdot 012 \text{ d.} \end{array}$$

∴ exact value = $\underline{5\text{s. } 7\tfrac{3}{250}\text{d.}}$ Ans.

Grammar.

1. *Transitive* is derived from the Latin *transire*, 'to go across,' the action as it were passing over from the *doer* to the object; in *in*-transitive verbs the action does *not* thus pass over, hence the name.

2. (*a*)

No.	Kind of Sent.	Connective.	Full Subject.	Predicate.	Completion of Pred.	Extension of Predicate.
1.	Adverbial.	When	I	came	to my castle	
2.	Principal.		I	fled		into it (*place*) like one pursued (*manner*)
3.	Noun (object).	Whether	I	went	over	by the ladder (*means*)
4.	„ „	or	(I)	went	in	at the hole (*place*)
5.	Adjective (to 4).		I	called	which (direct obj.) a door (indirect obj.)	
6.	Principal.	(and)	I	cannot remember	(3, 4, 5, form object)	
7.	Principal.	nor (= and not)	I	could (not) remember	„ „	the next morning (*time*)

NOTE.—*No* is equivalent to such a sentence as—*I could not remember.*

(*b*) *like*—adverb modifying *fled* (some consider *like* a prep.).
one—indef. pron. masc. sing. obj. gov. by (*to*) (some would say gov. by *like*).
pursued—complete part. of the reg. verb *pursue*. qual. *one*.
went—intrans. verb, strong conj. *go, went, gone*, indic. past indef., 1st pers. sing. agreeing with *I*.
no—negative adverb equivalent to a sentence. (*See note to analysis.*)
nor—conj. (= and not) negative, connecting '*I cannot remember*,' and '*I could* (*not*) *remember*.'
could—auxiliary verb (defective) indic. past indef. 1st pers. sing. agreeing with *I*, and forming with the infinitive.
remember—the past indef. potential of the reg. trans. verb.
I—1st pers., pron., masc., sing., nom., subj. of *could*.
the next morning—adverbial phrase mod. *could remember* or
the—def. art., or a disting. adj., qual. *morning*.
next—adj., superl. deg., *near, nearer, nearest* or *next*, qual. *morning*.
morning—abstr. noun, neut., sing., obj., gov. by (*on*).
than—comparative conj. connect. '*never frighted hare fled to cover*' and '*I (fled) to this* retreat.'
I—1st pers. pron. masc. sing., nom to (*fled*).

Geography.

2. River Jordan.—*Source*—Nearly in the latitude of Tyre, main sources situated among the Mountains of Anti-Lebanon—these feeders unite in Lake Bahr-Haleh.

Course and character—Flows southwards, feeding Lakes Samochonitis (Waters of Merom) and Gennesaret, and empties its waters into the Dead Sea—it is a swift, dark-coloured stream about 200 miles long, including windings, but in a direct course about 70 miles—numerous islets scattered along its course—which is also interrupted by about 27 rapids.

Valley of the Jordan—Hemmed in by a range of steep and lofty hills on both sides, gradually approaching as they go south. Thirty or forty feet below this greater valley lies a smaller one, forming the channel of the river, which, when swollen, completely fills it, and even overflows its borders. This lower valley has its edges covered with the most luxuriant vegetation, like a long oasis in a desert; from Sea of Tiberias or Lake Gennesaret, which is 328 feet below the level of the Mediterranean, the Jordan continues a rapid course to the Dead Sea, which is 3,000 feet below the same level.

Incidents—Crossing of Israelites—baptism of Jesus—other Biblical notes.

History.

1. Henry VII. was the *son of Margaret Beaufort*, great-grand-daughter of John of Gaunt. The title which he bore before his accession to the throne was *Earl of Richmond* through his father, Edmund Tudor.

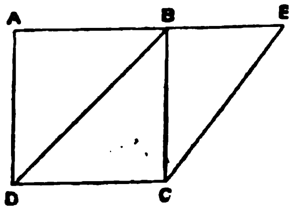
2. Queen Mary, daughter of *Henry VIII.* and *Catharine of Aragon* (A.D. 1553—1558).
Queen Elizabeth, daughter of *Henry VIII.* and *Anne Boleyn* (A.D. 1558—1603).
Queen Anne, daughter of *James II.* and *Anne Hyde* (A.D. 1702—1714).
Queen Victoria, daughter of *Edward D. of Kent*, and *Victoria of Saxe-Coburg* (1837).

Anne was a strict Protestant of the High Church School, and always attached to the Tory party in politics. She was diligent and careful in public business, though of moderate ability; good-hearted, but rather weak in submission to her favourite the Duchess of Marlborough. She had high notions of the royal perogative, but, in the main, governed according to the nation's will expressed through Parliament. Privately, she was a lady of simple and homely tastes and habits.

3. George Grenville having imprudently extended the *Stamp Act* to the North American Colonies, they objected to it on the principle of *no taxation without representation*. Though the Stamp Act was repealed, yet Parliament maintained their right to tax the Colonies, which was the great point in dispute. In course of time other taxes were imposed, and among these a tax was laid upon tea, which the British Government insisted upon. The colonists refused to make use of it or any imported goods until the duty was removed. In 1773, a band of men threw a cargo of tea into Boston harbour, and to punish the people of this town the English Government shut up the port and suspended the Charter of Massachusetts. This last act was fatal, and, eventually, in 1775, the first outbreak took place at Lexington.

Euclid.

1. Prop. 30, Bk. I.
2.



Let ABCD be a given square. Bisect it by the diagonal BD. Now since CD equals CB the angle CDB, = angle CBD, and therefore, each of them is half a right angle. Through C draw CE parallel to DB, and produce AB to E. Then DBEC is the parallelogram required; for it is equal to the square ABCD, because it is on the same base DC, and between the same parallels DC and BE, and it has the angle BDC equal to half a right angle.—Q. E. F.

3. Prop. 40, Bk. I.

Algebra.

1. (*a*)
$$\begin{array}{r}4x^2 - 2xy - y^2\\ 4x^2 - 2xy + 3y^2\\ \hline 16x^4 - 8x^3y - 4x^2y^2\\ - 8x^3y + 4x^2y^2 + 2xy^3\\ 12x^2y^2 - 6xy^3 - 3y^4\\ \hline 16x^4 - 16x^3y + 12x^2y^2 - 4xy^3 - 3y^4\end{array}$$

(*b*) $$\frac{-91a^3b^2x^3}{-13\ b^2x^3} = \underline{7a^3}.\ \text{Ans.}$$

2. $$\frac{85\,(20a^4+a^2-1}{102\,(25a^4+5a^3-a-1)} = \frac{17\times5\,(5a^2-1)\,(4a^2+1)}{17\times6\,(5a^2-1)\,(5a^2+a+1)}$$

$$\text{G.C.M.} = 17\,(5a^2-1)\ \therefore\ \text{L.T.} = \underline{\left(\frac{5\,(4a^2+1}{6\,(5a^2+a+1)}\right)}.\ \text{Ans.}$$

3. (1) $$\frac{x - 7655}{\cdot23} - \cdot1x = \cdot7$$

Multiplying by 23000

$$\begin{aligned}1000x - 7655 - 23x &= 161\\ 1000x - 23x &= 161 + 7655\\ 977x &= 7816\\ x &= \underline{8}\ \text{Ans.}\end{aligned}$$

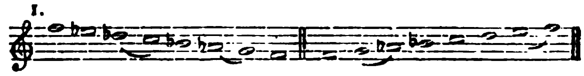
(2) $$\frac{x-3}{x-2} + \frac{x-4}{x-3} = 2$$

Multiply by L. C. denominators $(x-2)\,(x-3)$

$$\begin{aligned}\therefore\ x^2 - 6x + 9 + x^2 - 6x + 8 &= 2x^2 - 10x + 12\\ 2x &= 5\\ x &= \underline{2\tfrac{1}{2}}.\ \text{Ans.}\end{aligned}$$

Music.

1.



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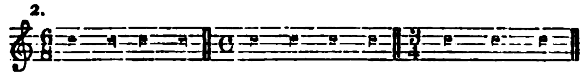


3.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May*, 1878; **and Pupil Teachers at end of Fifth Year, if apprenticed before that date.**

Three hours and a-half allowed.

Arithmetic.

MALES.

1. If bar iron which cost in making £41 13s. 4d. per ton be sold at a loss of $5\frac{3}{4}$ per cent., what price did it fetch per cwt.?

2. I invest £18,150 in 3 per cents. at $90\frac{3}{4}$, and on their rising to 91 transfer my money to $3\frac{1}{2}$ per cents. at $97\frac{1}{2}$; what increase do I make thereby in my annual income?

3. What would be the purchase money of a row of houses producing a rental of £3,228 3s. 4d. at the rate of 8¾ per cent.?

4. Find the true present worth of, and discount on, £226 1s. 11d. due 7 months hence, at 4⅜ per cent.

5. 'The standard gold coin of this realm is made of a metal of which 22 parts in 24 are pure gold and 2 parts alloy. From a pound troy of this metal are coined 46$\frac{29}{40}$ sovereigns.' What is the value per oz. of (*a*) standard gold, and (*b*) pure gold, at the Mint? and what percentage of the latter is the former?

FEMALES.

1. To what sum will £725 accumulate in 4 years at 5 per cent. compound interest?

2. A man and a boy working together can do ·61 of a piece of work in two days; the man working by himself could have done the work in 4 days; how many days will it take the boy working by himself to do it?

3. How many heifers must a person buy at £8 10s. each, so that after allowing 3s. 8d. for the food of each for a week, he may then, by selling each of the lot at £9 4s. 7d., gain £43 2s. 5d.?

4. What fraction of $\frac{5}{17}$ of 11 qrs. 5 bus. 2 pks. is equal to ⅘ of 9 qrs. 1 bus. 1⅓ pk.?

Grammar.

1. Are Anglo-Saxon and English different languages; or what is their relation to one another?

2. 'The Batavian territory, *conquered* from the waves and *defended* against them by human art, was in extent little superior to the principality of Wales; but *all that* narrow space was a busy and populous hive, in which new wealth was *every day created*, and in which vast masses of old wealth *were hoarded*.'

MACAULAY.

(*a*) How many different sentences are contained in the above? Assign each to its proper class.
(*b*) Parse the words in italics.

3. When should the word '*the*' be considered as an adverb? Give instances.

Geography.

1. Give full notes of a lesson on 'The River Jordan.'

2. Describe fully the Arctic Ocean, and the seas, bays, gulfs, and straits connected with it.

Draw a map to illustrate *one* of your answers.

History.

1. How many of our kings have borne the name of Edward? Give their dates, and sketch the character of one of them.

2. When, where, and between what nations were the battles of the Nile and Trafalgar fought? Why were they of great importance to England?

3. Explain the meaning and importance of the parliamentary principle: No supplies before redress of grievances.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word, *Apprehensive.*

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act.*

Composition.

Describe any interesting scene you have witnessed, or excursion you have made in your last holidays.

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. Bisect a triangle by a line drawn through a given point in one of the sides.

2. If a straight line be divided into any two parts, the rectangles contained by the whole and each of the parts are together equal to the square on the whole line.

3. To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square on the other part.

Algebra.

1. Prove the rule for finding the product of two fractions.

Divide $\frac{4a'a^2 - x^2)}{3b(c^2 - x^2)}$ by $\frac{a^2 - ax}{bc + bx}$

2. Find the square root of—

$$x^6 + 4x^5 + 10x^4 + 20x^3 + 25x^2 + 24x + 16.$$

3. Solve the equations:—

$$(1)\quad \frac{1}{ab - ax} + \frac{1}{bc - bx} = \frac{1}{ac - ax}$$

$$(2)\quad \begin{cases} \dfrac{x + 2}{7} + \dfrac{y - x}{4} + 2x - 8 \\ \dfrac{2y + 3x}{3} + 2y = 3x + 14 \end{cases}$$

$$(3)\quad 45x^2 - 25x = 1000.$$

Mensuration.

1. The sides of a triangle are in the proportion of the numbers 13, 14, 15; and the perimeter is 70 yards. Find the area.

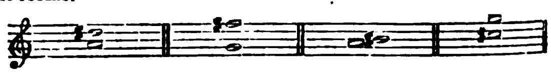
2. A circle is 4 ft. in circumference; find the area of a square described about it.

Music.

A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of C (*Do*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.

2. Write, under each of the following pairs of notes, the name and quality (major, perfect, diminished, or other) of the interval it forms.



3. Transpose the following into D (*Re*).

ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. Selling price of 1 cwt. $= \frac{1}{20}$ of £$41\frac{2}{3} \times \frac{94\frac{5}{8}}{100}$

" $= £\frac{125}{3} \times \frac{757}{800} \times \frac{1}{20}$

" $= £\frac{757}{384}$

i.e., £1 19s. 5⅛d. Ans.

2. 1st income $=$ £$18150 \times \frac{12}{363} = 50 \times 12 = 600$ 0 0

2nd " $= £\frac{18150 \times 91}{90\frac{3}{4}}$ new stock $\times \frac{3\frac{1}{2}}{97\frac{1}{2}}$

" $= £\frac{18150 \times 364 \times 7}{363 \times 195}$

$= £\frac{1960}{3}$ *i.e.*, 2nd income $= 653$ 6 8

∴ diff. of income is £53 6 8 Ans.

3. £100 of house property raised £8¾

∴ £1 is raised from $\frac{100}{8\frac{3}{4}}$

And 3228⅙ " $£\frac{19369}{6} \times \frac{400}{35}$

" " *i.e.*, $£\frac{110680}{3} = £36,893$ 6s. 8d.

4. $£4\frac{3}{4} \times \frac{7}{12} = \frac{19 \times 7}{4 \times 12} = £\frac{133}{48}$ interest of £100 for 7 mos.

$\therefore £\frac{133}{48}$ is the discount on $£100\frac{133}{48}$ or $£\frac{4933}{48}$

and the $£\frac{4933}{48} : £\frac{133}{48} :: £226\frac{23}{240}$: discount required.

$£\frac{54263}{240} \times \frac{133}{4933} = £\frac{11 \times 133}{240} = \underline{£6 \text{ 1s. 11d.}}$

$\therefore$ the pres. val. of £226 1s. 11d. $= \underline{£220 \text{ 0s. 0d.}}$

5. (*a*) $46\frac{29}{40} \div 12 = £\frac{46 \text{ 14s. 6d.}}{12} =$

$\underline{£3 \text{ 17s. } 10\frac{1}{2}\text{d.}}$ price of 1 oz. Standard gold.

(*b*) Now since there are 11 oz. of *pure* gold in 12 oz. of *Standard* we shall have (neglecting the value of the alloy) the value of 1 oz. *pure* gold at the Mint $= \frac{1}{11}$ of £46 14s. 6d. $= \underline{£4 \text{ 4s. } 11\frac{5}{11}\text{d.}}$ Ans.

(*c*) To find the percentage that (*a*) is of (*b*)

we have $\frac{£3 \text{ 17s. } 10\frac{1}{2}\text{d.} \times 100}{£4 \text{ 4s. } 11\frac{5}{11}\text{d.}} = \frac{1869 \text{ halfpence} \times 100}{2038\frac{10}{11} \text{ halfd.}} =$

$\frac{2055900}{22429} = \underline{\frac{275}{3}} = 91\frac{2}{3}$ p.c. Ans.

FEMALES.

1. 5 per cent. of interest $= \frac{1}{20}$ of principal per annum.

	£725
	36·25
Amt. at end of 1st year =	761·25
	38·0625
" " 2nd " =	799·3125
	39·965625
" " 3rd " =	839·278125
	41·96390625
" " 4th " =	881·24203125
	20
	4·8406250s.
	12
	10·0875d.

$\therefore$ £725 accumulates to $\underline{£881 \text{ 4s. } 10\frac{7}{80}\text{d.}}$

2. *Man* and *boy* do $\frac{11}{18}$ or $\frac{22}{36}$ in 2 days, *i.e.*, $\frac{11}{36}$ in 1 day.
The man alone does $\frac{1}{4}$ in 1 day, *i.e.*, $\underline{\frac{9}{36}}$

$\therefore$ the boy alone in 1 day does $\frac{1}{18}$
And so the boy will do the whole in $\underline{18}$ days.

3. Each heifer costs him, in all, £8 13s. 8d.
" is sold for ... £9 4s. 7d.
$\therefore$ he gains on each ... 10s. 11d.
$\therefore$ £43 2s. 5d. will be gained on £43 2s. 5d. ÷ 10s. 11d.
" " " $\frac{10349\text{d.}}{131\text{d.}}$
i.e., $\underline{79}$ heifers. Ans.

4. $\frac{\frac{3}{8} \text{ of } 9 \text{ qrs. } 1 \text{ bush. } 1\frac{1}{3} \text{ pks.}}{\frac{5}{17} \text{ of } 11 \text{ qrs. } 5 \text{ bush. } 2 \text{ pks.}} = \frac{\frac{3}{8} \text{ of } 293\frac{1}{3} \text{ pks.}}{\frac{5}{17} \text{ of } 374 \text{ pks.}} =$

$\frac{880}{8} \div 110 = \underline{1}$. Ans.

Grammar.

1. *Modern English* is only a somewhat altered form of the language brought into England by the Saxons and Angles, and which, in its early form, is commonly called *Anglo-Saxon*. The grammatical framework of Modern English is still purely Anglo-Saxon. As regards its form Anglo-Saxon had a much greater number of inflexions than modern English. In A. S., nouns had five cases and their different declensions, adjectives were declined, and had three genders, &c. The greater part of these inflexions were dropped in course of time and their functions are now served by such words as prepositions and auxiliary verbs. This change is what is meant when it is said that ancient English —Anglo-Saxon —was an *inflected* and *modern English* an *analytic* language.

2. (*a*.)

KIND OF SENT.	SENTENCES.
1. Principal.	The Batavian territory, conquered from the waves and defended against them by human art, was in extent little superior to the principality of Wales.
2. Principal, *in adversative co-ordination with* (1).	But all that narrow space was a busy and populous hive.
3. Adjective, *to 'hive' in* (2.)	In which new wealth was every day created.
4. Adjective, *to 'hive' in* (2).	(And) in which vast masses of old wealth were hoarded.

(*b*.) *conquered*—complete part. of reg. trans. verb *to conquer*, qual. *territory*.
defended—complete part. of reg. trans. verb, *to defend*. qual. *territory*.
all—indef. num. adj. qual. *space*.
that—disting. adj. qual. *space*.
every—distrib. adj. qual. *day*.
day—abstr. noun. neut., sing. obj. (*of time*) gov. by (*on*).
created—complete part. of the reg. trans. verb to *create*, forming with *was*, past indef. indic. passive.
were—auxiliary v. of voice, *am*, *was*, *been*, indic. past indef. 3rd pers. plur. agreeing with *masses*, and forming with the complete part.
hoarded—past indef. indic. passive voice.

3. The word '*the*' is considered an adverb when it stands before comparatives, as:—'*The* sooner, *the* better.' '*The* nearer the bone, *the* sweeter the meat.' '*The* more *the* merrier.' It is the old *ablative* or *instrumental* case of the *demonstrative adjective* '*the*.'

Geography.

1. *See same question answered 'Third Year' of this number of Magazine.*

2. The Arctic Ocean is the name given to the expanse of water which extends from lat. 66° 30′ N. to the North Pole. It communicates with the Atlantic by a wide opening between Greenland and Norway, and by a narrow channel on the west of Greenland, called Davis Strait. With the Pacific it communicates through Behring's Strait. The Arctic Ocean is nearly circular in form, and is almost land-locked by the northern coasts of the Old and New Worlds. The ice-bound condition of this Ocean has utterly baffled all attempts hitherto made to penetrate to the Pole. It encroaches on Europe in the *White Sea*, on Asia in the Gulfs of *Kara*, *Obi*, *Yenesei*. Between Asia and Alaska is the Strait of Behring. The northern shores of America are extremely indented and crowded with islands, thus forming numerous gulfs, bays, straits, and channels, the principal being *Baffin Bay*, extended by *Smith Sound*, *Kennedy*, and *Robeson Channels*, *Lancaster Sound*, *Barrow Strait*, *Melville Sound*, and *Banks Strait*; *Coronation Gulf*, *Dease Strait*, *Simpson Strait*, *Gulf of Boothia*, *Fury* and *Hecla Strait*, *Fox Channel*, and *Hudson Strait*.

History.

1. Six of our Kings have borne the name of Edward :—

Edward I.	reigned	from 1272 till 1307.
Edward II.	"	1307 " 1327.
Edward III.	"	1327 " 1377.
Edward IV.	"	1461 " 1483.
Edward V.	"	in 1483 for 3 mos.
Edward VI.	"	from 1547 till 1553.

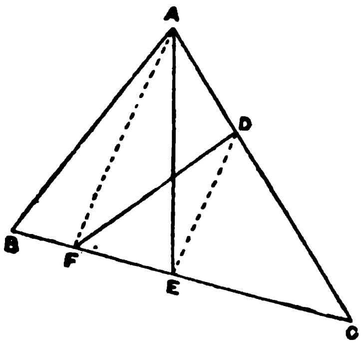
Edward VI. was a pious boy, of feeble health, well instructed, and warmly in favour of the Reformed doctrines. During his short life he was regarded by the Protestant party with the hopeful affection given to one who promised to be a wise and able, if not a vigorous ruler.

2. The battle of *the Nile* was fought *August 1st*, 1798, in *Aboukir Bay*, west of the mouths of the Nile, *between the French and the English fleets*. The gaining of this battle by the British Admiral Nelson prevented Napoleon from carrying out his grand scheme for the conquest of our Indian Empire. The battle of *Trafalgar* was fought *Oct. 21st*, 1805, off that cape, which is south of Cadiz in Spain. Here *the English* fleet, under Nelson, defeated *the combined French and Spanish fleets*, and thus for ever destroyed all fears of a French invasion of England.

3. Members of the House of Commons have both a right to object to the expenditure of certain moneys and to oppose the granting of supplies altogether until all grievances are redressed. The rules of the House give members absolute power in this respect, and they have frequent opportunities of exercising this right. Thus, when the House is going into Committee of Supply, any member has the liberty of rising in his place and objecting to their going into Committee, on the ground that the people at large or of his constituency are suffering from any grievance or wrong which he thinks the Crown should be made to redress before any money is granted for carrying on the government of the country. Of course a majority of votes would be required to carry his motion; but generally speaking now-a-days members are quite satisfied with merely stating their grievance. However, it is customary for responsible ministers to promise that these wrongs will be inquired into. It is evident from this that the people possess great power over the Crown, and that no grievance of any consequence can remain unredressed.

Euclid.

1.



Let D be the given point. Bisect the side BC in E. Join AE, DE, and through A draw AF parallel to DE. Join DE. DE shall be the straight line required.

Because the triangles DFE, AED are upon the same base DE and between the same parallels, they are equal to one another; but the triangle DGE is common to both, and therefore the remainders AGD GFE are equal. Now the triangles ABE AEC are equal, being upon equal bases and having a common vertex. Take away from each the parts FGE AGD respectively and the remainders AGFB DGEC are equal, and so, by adding AGD to AGFB, and GFE to DGEC, the whole ADFB is equal to the whole DFC. That is the straight line DF bisects ABC.—Q.E.F.

2. Prop. 2. Bk. II.

3. Prop. 11. Bk. II.

Algebra.

1. (*a*) The rule for finding the product of two fractions is, 'Multiply the numerators of the fractions together for a new numerator and the denominators for a new denominator.'

For if $\frac{p}{q}$ and $\frac{r}{s}$ be the given fractions, let us suppose that

$$\frac{p}{q} = m, \text{ and } \frac{r}{s} = n.$$

then $p = qm$, and $r = sn$;

$\therefore pr = qsmn$;

dividing these equals by qs we have

$$\frac{pr}{qs} = mn;$$

but $mn = \frac{p}{q} \times \frac{r}{s}$, and $\frac{pr}{qs} = \frac{p \times r}{q \times s}$;

therefore $\frac{p}{q} \times \frac{r}{s} = \frac{p \times r}{q \times s}$ *i.e.*, $\frac{\text{product of numerators.}}{\text{product of denominators.}}$

(*b*) $$\frac{4a(a^2-x^2)(bc+bx)}{3b(c^2-x)(a^2-ax)} = \frac{4a(a+x)(a-x)(c+x)b}{3b(c-x)(c+x)(a-x)a} =$$

(after striking out factors) $\frac{4(a+x)}{3(c-x)}$. Ans.

2.
$$\begin{array}{r|l}
x^3 & x^6+4x^5+10x^4+20x^3+25x^2+24x+16\,(\underline{x^3+2x^2+3x+4} \\
 & x^6 \\ \hline
2x^3+2x^2 & 4x^5+10x^4 \\
 & 4x^5+\ \ 4x^4 \\ \hline
2x^3+4x^2+3x & 6x^4+20x^3+25x^2 \\
 & 6x^4+12x^3+\ \ 9x^2 \\ \hline
2x^3+4x^2+6x+4 & 8x^3+16x^2+24x+16 \\
 & 8x^3+16x^2+24x+16 \\ \hline
\end{array}$$

3. (1) $$\frac{1}{a(b-x)} + \frac{1}{b(c-x)} = \frac{1}{a(c-x)}.$$

Multiplying by $ab(b-x)(c-x)$

$$\therefore bc - bx + ab - ax = b^2 - bx$$
$$bx - bx - ax = b^2 - bc - ab$$
$$ax = ab - b^2 + bc$$
$$x = \frac{b}{a}(a - b + c).$$

(2) (*a*) $$\frac{x+2}{7} + \frac{y+x}{4} = 2x - 8$$

(Multiplying by 28) $4x + 8 + 7y - 7x = 56x - 224$

$$59x - 7y = 232$$

(*b*) $$\frac{2y+3x}{3} + 2y = 3x + 14$$
$$2y + 3x + 6y = 9x + 42$$
$$3x - 4y = -21$$

From (*a*) $236x - 28y = 928$

" (*b*) $21x - 28y = -147$

by subtraction $215x = 1075$

$x = \underline{5}$

And by substitution $y = \underline{9}$

3. Dividing each side by 5,

$$9x^2 - 5x = 200$$

Dividing by 9, $x^2 - \frac{5}{9}x = \frac{200}{9}$

Completing square $x^2 - \frac{5}{9}x + \frac{25}{324} = \frac{7200+25}{324} = \frac{7225}{324}$

Taking root $x - \frac{5}{18} = \pm \frac{85}{18}$

$x = \frac{5}{18} \pm \frac{85}{18} = \underline{5 \text{ or } -4\frac{4}{9}}$. Ans.

Mensuration.

1. 1st side is $\frac{13}{42}$ of 210 ft. or 65 ft.

2nd " $\frac{14}{42}$ " " 70 "

3rd " $\frac{15}{42}$ " " 75 "

$\frac{65+70+75}{2} = 105$ ft. half the sum of sides.

$\therefore$ Area = the square root of

$105 \times (105-65) \times (105-70) \times (105-75) =$

$\sqrt{105 \times 40 \times 35 \times 30} = \sqrt{4,410,000} =$

2100 sq. ft. or 233 sq. yds. 2 ft. Ans.

2. Area of described square = square of the diameter of the inscribed circle.

Diameter = 4 ft. ÷ 3·1416 and

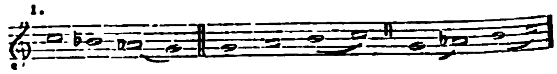
$\therefore \left(\frac{4}{3\cdot1416}\right)^2$ = area of square

$= \frac{16}{9\cdot86965}$ ft.

i.e., 1·621 sq. ft. Ans.

Music.

1.



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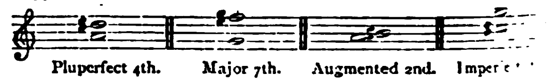
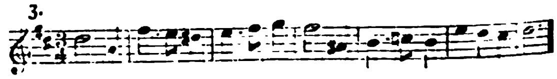


Pluperfect 4th. Major 7th. Augmented 2nd. Imperfect

3.



Query Column.

☞ **As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'**

RULES.

1. Each correspondent is restricted to *one question*.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. Replies will not be sent through the post.

4. Correspondents are requested to write *legibly*, and on one side of the paper only.

5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.

6. Queries must reach the office *not la'er than the 15th oj the month*, or they cannot be attended to in the following issue.

⁂ All communications for this column should be addressed

'The Query Editor,'
The Practical Teacher,
Pilgrim Street, Ludgate Hill,
London, E.C.

1. FOURTH-YEAR P. T., Skelmanthorp.—The Syllabus you can order through any bookseller. Write to Messrs. W. Stewart and Co., Holborn Viaduct Steps, for their catalogue of Certificate and Scholarship publications.

2. GEORGE BURGE, Hodnet.—We make no exception to our rules, not even 'for this once.' The B.A. questions set at London are only published in the Calendar for the year after. The price of each Calendar is 4s. No answers given. Messrs. Stewart, perhaps, have a book that would suit you in this particular.

For *Co-ordinate Geometry* read Todhunter's Treatise (Macmillan, 7s. 6d.). No Key published, but answers are given. Only the chapters on the Straight Line, not including Abridged Notation, and the Circle.

3. JESSIE, Glasgow.—We do not reply to anonymous correspondents. Please let us have your name and address. In consideration of your munificent offer, the Editor has consented that a short account of the Unitary System shall appear in the body of the Journal, probably in our next issue. We direct your attention, and your amorous friend's also, to this for further information.

4. H. A. D., Iron Acton.—Cassell's *Educational Year-Book* will supply you with a better list of Training Colleges than we could. Publisher, Cassell.

5. J. BAGSHAW, Ashbourne.—You are certainly not wrong in considering the clauses as complementary. Thanks for calling our attention to this.

6. POLLY.—Don't you see that by an inadvertence the *first amount* was substituted for the principal? Yours is the correct answer.

7. O. H. F., Dover.—We regret that your proposal cannot be carried out, as the pressure upon our space is so great. Next year we hope to have a section of special benefit to Certificate Candidates. If there is any question in last year's papers that you cannot work, avail yourself of the *Query Column*.

8. R. E. T., Aberdare.—At what rate per cent. *Compound Interest* will £750 amount to £826 17s. 6d. in 2 years?

The amount of £M for x years at y per cent is £M $\left(1+\frac{y}{100}\right)^x$

If this be £P.

$$M\left(1+\frac{y}{100}\right)^x = P$$

$$\therefore \left(1+\frac{y}{100}\right)^x = \frac{P}{M}$$

$$\therefore\ y = 100\left\{\left(\frac{P}{M}\right)^{\frac{1}{x}} - 1\right\}$$

This at once suggests the method.

P is £826⅞. M is £750. $x=2$.

$$\frac{P}{M} = \frac{6615}{6000} = \frac{441}{400}$$

The square root of this is $\frac{21}{20}$.

$$\therefore\ y = 100\left(\tfrac{21}{20} - 1\right) \text{ or } 5.$$

At first sight this method seems Algebraical, but it will be found that the principles involved are solely Arithmetical.

The above method is always the best for Compound Interest. Thus interest on £100 for 10 years at 5 per cent. is £100 $\{(1{\cdot}05)^{10} - 1\}$, for 14 years. £100 $\{(1{\cdot}05)^{14} - 1\}$ and $(1{\cdot}05)^{14}$ will be found to be very nearly equal to 2, so that the Interest for 14 years is very nearly equal to the Principal. It is *always* the best method when the answer is required approximately only.

9. H. TAYLOR, Herne Hill.—A stone dropped down a pit is heard to strike the bottom 7 seconds after it left the hand. Find the depth of the pit, supposing the velocity of sound to be 1,120 feet per second.

Let x feet be depth of pit. Sound reaches the ear (supposed at level of pit's mouth) in $\frac{x}{1120}$ seconds, and therefore the stone took $7 - \frac{x}{1120}$ seconds to fall. Now the depth fallen in any time is proportional to the square of the time from commencement, and a stone falls 16 feet in the first second.

$$\therefore \text{ the depth fallen} = x$$

$$= 16\left(7 - \frac{x}{1120}\right)^2$$

(Dynamically $s = \frac{1}{2} ft.^2$ and f here is g).

$$x = \left(28 - \frac{x}{280}\right)^2$$

$$\frac{x^2}{78400} - \frac{x}{5} + 784 = x$$

$$\therefore\ x^2 - 94080x + 61465600 = 0$$

$$\therefore\ (x - 47040)^2 = 2151296000$$

$$x - 47040 = \pm 46382 \text{ nearly.}$$

The upper sign gives for the depth of the pit 93,422 feet.

This is an answer which, though it satisfies the equation $s = \frac{1}{2}$ ft.^{2} is an Algebraical solution only, and is inconsistent with the conditions.

The other answer—658—is the correct one approximately enough.

10. T. BINFIELD wishes to know, on behalf of a subscriber in Ceylon, how to pronounce the outrageously barbarous names of some wretched places which the Query Editor is ignorant enough not to have heard of. To show the tribulations through which we, in our ignorance of Tamil and dialects, have to pass, we lay the question open for general competition.

"How do you pronounce Akiba, Kshatriyas, Jawari, Ragi, Crore?"

No one is allowed to make more than a dozen guesses at each.

Your decimal should be read: ten, decimal, cipher, cipher, eight, one, *i e.*, 10·0081.

What are called "proportional compasses" would help you in your map-drawing. Obtain of any mathematical instrument maker at 2s. 6d.

11. NITOR, Cherrybank.—The data are insufficient, as you yourself remark. We think, perhaps, that the original rate of one of the travellers should have been given, or a relation between their two rates.

12. R. BLACK, Prudhoe-on-Tyne.—If the estimated annual value of the property in a certain parish consist of the yearly rent paid to the landlord, together with the rates, and the rates be calculated upon the rent after a reduction of 30 per cent.; find the rateable value of a tithe-rent charge, the calculated annual value of which is £884 per annum, when the rates amount to 3s. in the pound. (*Barnard Smith.*)

Suppose the rents to be £1. After a reduction of 30 per cent., *i.e.*, $\frac{3}{10}$, this becomes £$\frac{7}{10}$. On this the rates are 3s. in the £, *i.e.*, $\frac{3}{20}$. Hence the amount of the rates is £$\frac{3}{20}\times\frac{7}{10}$ or £$\frac{21}{200}$. Hence the annual value is £$1+$£$\frac{21}{200}$ or £$\frac{221}{200}$. Hence the rents are $\frac{200}{221}$ of annual value, *i.e.*, £$\frac{200}{221}$ of 884; *i.e.*, £800. To get the rateable value we must make a reduction of 30 per cent. on this, *i.e.*, it is £$\frac{7}{10}\times 800$ or £560.

13. YARICO, Bridlington.—You must excuse us if, not understanding your data, we fail to get an answer at all resembling yours.

14. ADA.—The Diatonic Scale has two modes—major and minor. Any good elementary work on music will show how the sequences of tones and semitones recur in these respective modes, and also the melodic changes made in the minor ascending scale from its more normal descending form. The definition you have adopted applies only to the major and not to the minor Diatonic Scale.

15. W. C. U.—For a Pupil Teacher in the second year it would require some five or six years' devotion to the study and practice of music—taking into consideration the fulfilment of other duties—to obtain a B.M. degree. Unless you have proved aptitude for music and resolute determination to carry on this lengthened course of study, don't think for several years about this B.M. degree. Mozart could obtain it in less time, but then Mozart had no sums to do. Besides, you may not be a Mozart. Work as diligently as you can at music as at everything else, but 'aim not too high.' Study well and the degree will come in time, but don't think about it yet. All needful information can be obtained from the officials of the Universities.

16. SUBSCRIBER, Rippingale.—A pupil-teacher must serve four years before he can try for the Scholarship Examination.

17. R. GIBBONS, Stockport.—If a certain field will graze two oxen and three horses for 21 days, or three oxen and two horses for $19\frac{20}{31}$ days, compare the appetite of an ox and a horse.

In this question, since there are only two data, we are not meant to take any account of the growth of the grass.

2 oxen and 3 horses for 21 days.
3 oxen and 2 horses for $19\frac{20}{31}$ days.

Hence it is obvious that if x and y be the appetites of an ox and a horse respectively

$$(2x+3y)\ 19\tfrac{20}{31}=(3x+2y)\ 21$$
$$\text{or } (2x+3y)\ \tfrac{609}{31}=(3x+2y)\ 21$$
$$\text{or } (2x+3y)\ 29=(3x+2y)\ 31$$
$$\text{or } 58x+87y=93x+62y, \text{ or } 25y=35x$$

$5y=7x \quad x:y::5:7$. The methods involved are purely Arithmetical. You did not tell us whether Arithmetic or Algebra was intended.

18. Several Queries from Cheap Street, Sherborne, are unanswered, because the Querist did not favour us with his name.

19. J. WORMALD, Lofthouse.—

$$\text{Solve } (x-2)\ (x-3)=3\ (5x+14)$$
$$x^2-5x+6=15x+42$$
$$x^2-20x=36$$
$$x^2-20x+100=136$$
$$x-10=\pm\sqrt{136} \qquad x=10\pm2\sqrt{34}$$

20. J. B. M., Meikleour.—Arnold's *Greek Prose Composition*. Same publisher as his other work, and same price, we believe. Parry's *Greek Grammar*. Longmans, 3s. 6d.

You are a little hypercritical on poor Query No. 9 of the June number. You say our construction is impossible, our "directions cannot be carried out." Instead of making $\angle CAD=\angle ADB$ on the side on which you have drawn it, try the other side and you will agree with us.

21. P. T., Cotmanhay.—Given that the square of 10129 is 102596641, find the square of 101293 without going through the operation of squaring.

We know from an easy theorem in Algebra that

$$(a+b)^2=a^2+2ab+b^2$$
$$\therefore\ (101293)^2=(101290+3)^2$$
$$=(101290)^2+6(101290)+9$$
$$=10259664100$$
$$607740$$
$$\underline{\qquad 9}$$
$$10260271849$$

22. KAPPA, Weston-super-Mare.—There is no difficulty in your passage, or we would translate it for you. Try yourself and send us your efforts to be corrected, if you like, but do not attempt to make us into a "key."

23. H. C. S., Ashford.—The inscription is old Spanish. We cannot help you.

24. R. HALL, Weston-super-Mare.—A man bought 63 sheep and sold $\frac{4}{9}$ of them at a profit of 15 per cent; $\frac{1}{7}$ at a profit of 50 per cent., and the remainder at a loss of 25 per cent. What did he pay for the sheep if his gain was £3 17s. on the whole?

$\frac{4}{9}$, *i.e.*, 28 at a profit of 15 per cent.
$\frac{1}{7}$, *i.e.*, 9 at a profit of 50 per cent.
The remainder 26 at a loss of 25 per cent.

Hence, by the ordinary rule of percentages, profit per cent. on the whole is

$$\frac{28\times15+9\times50-26\times25}{28+9+26}$$
$$\text{or } \frac{420+450-650}{63} \quad \text{or } \frac{220}{63}$$

But we are told that his profit was £3 17s., and we have just proved that this is $\frac{220}{63}$ per cent. of the price he gave for them.
∴ price is

$$\frac{63\cancel{0}}{\underset{2}{\cancel{22}}}\times\frac{\cancel{77}\ 7}{2\cancel{0}} \text{ or } \frac{441}{4} \text{ or } £110\ 5s.$$

25. X. K. D., Woking.—The price of gold is £3 17s. 10½d. per oz. A composition of gold and silver weighing 18 lbs. is worth £637 7s., but if the proportions of gold and silver were interchanged it would be worth only £259 1s. Find the proportion of gold and silver in the composition and the price of silver per oz.

Add the two compositions together. It is evident that we now have 18 lbs. of gold and 18 lbs. of silver, worth altogether £896 8s.

Hence 18 ozs. of gold and 18 ozs. of silver are worth £56 0s. 6d.

Hence 1 oz. of gold and 1 oz. of silver are worth £3 2s. 3d.

But since 1 oz. of gold alone is worth £3 17s. 10½d. your data are absurd.

26. SCRUTATOR, Dunstable.—Find the side of a square inscribed in a semi-circle whose radius is 5 feet. (Pupil Teachers' Examination, June, 1879.)

It is obvious, by considerations of symmetry, that one side of the square must lie along the bounding diameter of the semicircle, and that the middle point of this side must lie at the centre of the circle.

If C be the centre, and PNN′P′ the square, NCN′ being along the bounding diameter

$$CP^2=CN^2+PN^2=\left(\frac{NN'}{2}\right)^2+PN^2$$
$$=\frac{PN^2}{4}+PN^2=\frac{5PN^2}{4}$$
$$\therefore\ PN^2=\frac{4CP^2}{5}=\frac{4\times25}{5}=20$$
$$\therefore\ PN=2\sqrt{5}$$

Your writing promises to be fairly neat, not business-like enough, no dash about it. Still it is so much better than we usually receive that we cannot help repeating what the old Latin poet used to say, '*Ah! si sic omnia!*'

27. H. C. Ashton, Cardiff.—In any triangle the square described on the base is equivalent to the rectangles contained by the two sides and their segments, intercepted from the base by perpendiculars let fall upon them from the opposite extremities.

This is so vaguely worded that it took us some time to see what it meant. We presume it may be interpreted as follows:—

ABC is a triangle, BE perpendicular to AC, CF perpendicular to AB.

$$BC^2 = BA.BF + CA.CE$$

For the sake of simplifying the figure, suppose the angle at A to be obtuse.

Then, since BEC is a right angle, and also BFC, BEFC may be inscribed in a circle.

$$\therefore\ EA.AC = BA.AF$$
$$\text{But } CA.CE = CA(CA+AE) = CA^2 + CA.AE$$
$$\text{and } BA.BF = BA(BA+AF) = BA^2 + BA.AF$$
$$\therefore\ CA.CE + BA.BF = CA^2 + BA^2 + 2BA.AF$$
$$= BC^2 \quad \text{(Euc. II. 12.)}$$

The proof is almost exactly the same when BAC is acute, and when it is a right angle, of course the theorem is identical with I. 47.

28. Westward Ho, Bideford.—The area and any two sides of any triangle being known, to ascertain the third side.

We know that if a, b, c be the sides, $2s$ their sum, and Δ the area of the triangle

$$\Delta = \sqrt{s(s-a)\,(s-b)\,(s-c)}$$
$$\text{or } 16\Delta^2 = (a+b+c)(b+c-a)(c+a-b)(a+b-c)$$
$$= 2b^2c^2 + 2c^2a^2 + 2a^2b^2 - a^4 - b^4 - c^4$$

This may be written

$$a^4 - 2a^2(b^2+c^2) + (b^2-c^2)^2 + 16\Delta^2 = 0$$

Solving this quadratic in a^2

$$a^2 = b^2 + c^2 \pm \sqrt{(b^2+c^2)^2 - (b^2-c^2)^2 - 16\Delta^2}$$
$$\text{Hence } a = \sqrt{b^2 + c^2 \pm 2\sqrt{b^2c^2 - 4\Delta^2}}$$

This gives the third side, but of course it is absurd to learn this as a formula. You must work it out with each separate example. There is no simpler way.

29. Halifaxian, Halifax.—A right pyramid, 12 feet high, stands on a square base, of which the sides are each 10 feet, find the position of a plane, parallel to the base, which divides the pyramid into two equal parts.

It is a fundamental theorem in Mensuration and Solid Geometry that similar figures are to one another in the triplicate ratio of their homologous edges (analogue to VI. 19) or of any two lines similarly drawn in them. If then a plane is drawn, cutting off a little pyramid at the top, which is half the original and similar pyramid, it follows that its perpendicular height is to the perpendicular height of the original pyramid as $\sqrt[3]{\frac{1}{2}} : 1$

Hence the plane must be drawn at a distance of $\frac{12}{\sqrt[3]{2}}$ feet from the vertex, or $6 \times \sqrt[3]{4}$ feet.

30. W. Seymour, South Shields.—The sum of four numbers and the sum of their squares are each equal to unity. Show that five times the sum of their fourth powers differs by unity from four times the sum of their fifth power.

In other words

$$a+b+c+d = 1 \quad (1)$$
$$a^2+b^2+c^2+d^2 = 1 \quad (2)$$

Show that

$$5(a^4+b^4+c^4+d^4) = 4(a^5+b^5+c^5+d^5)+1$$

Square (1) and subtract (2)

$$ab+ac+ad+bc+bd+cd = 0$$

$$\text{Hence } (x-a)(x-b)(x-c)(x-d)$$
$$= x^4 - x^3(a+b+c+d) + x^2(ab+ac+\ldots)$$
$$- x(abc+abd+acd+bcd) + abcd$$
$$= x^4 - x^3 - x(abc+abd+acd+bcd) + abcd$$

Take logarithms of both members after dividing throughout by x^4

$$\log\left(1-\frac{a}{x}\right) + \log\left(1-\frac{b}{x}\right) + \log\left(1-\frac{c}{x}\right) + \log\left(1-\frac{d}{x}\right)$$
$$= \log\left(1 - \frac{x^3 + x(\ ) - abcd}{x^4}\right)$$
$$\therefore \text{ if } \epsilon^n = a^n + b^n + c^n + d^n$$
$$\frac{\epsilon^1}{x} + \frac{\epsilon^2}{2x^2} + \frac{\epsilon^3}{3x^3} + \frac{\epsilon^4}{4x^4} + \frac{\epsilon^5}{5x^5} +$$
$$= \left(\frac{x^3+px-abcd}{x^4}\right) + \frac{1}{2}\left(\frac{x^3+px-abcd}{x^4}\right)^2$$
$$+ \frac{1}{3}\left(\frac{x^3+px-abcd}{x^4}\right)^3 + \ldots\ldots \text{where}$$
$$p = abc+abd+acd+bcd$$

Now equate the co-efficients of $\frac{1}{x^4}$ on both sides of this

$$\frac{\epsilon^4}{4} = -abcd + \frac{2p}{2} + \frac{1}{4};$$

Also equating the coefficients of $\frac{1}{x^5}$

$$\frac{\epsilon^5}{5} = -\frac{2abcd}{2} + \frac{3p}{3} + \frac{1}{5}$$

This is seen at once by writing

$$\frac{x^3+px-abcd}{x^4} \text{ as } \frac{1}{x} + \frac{p}{x^3} - \frac{abcd}{x^4} \text{ and}$$

picking out the respective coefficients.

$$\text{Hence } \frac{\epsilon^4 - 1}{4} = -abcd + p$$
$$= \frac{\epsilon^5 - 1}{5}$$
$$\therefore\ 5(\epsilon^4 - 1) = 4(\epsilon^5 - 1)$$
$$\therefore\ 5\epsilon^4 = 4\epsilon^5 + 1. \qquad \text{—Q. E. D.}$$

There may possibly be a shorter way, but this is the one that naturally occurred to us.

31. R. S. O., Pontardawe.—A person bought a French watch, bearing a duty of 25 per cent., and sold at a loss of 5 per cent. Had he sold it for £3 more he would have cleared 1 per cent. on his bargain. What had the French maker for it? (*Barnard Smith.*)

He sold it at $\frac{95}{100}$ of its price.

Had he sold it for $\frac{101}{100}$, he would have got £3 more.

$$\therefore\ \tfrac{6}{100} \text{ of price} = £3$$
$$\therefore\ \text{Price} = £50$$

But there was a duty of 25 per cent. on the watch originally.

∴ The French maker had $\frac{4}{5}$ of £50, or £40 for it.

32. P. T., Newbury.—A person invests £18,150 in the 3 per cents. at $90\frac{3}{4}$, and, on their rising to 91, transfers to the $3\frac{1}{2}$ per cents. at $97\frac{1}{2}$. What increase does he make thereby in his annual income?

Total capital after selling out in the 3 per cents. is

$$£\frac{91}{90\frac{3}{4}} \times 18150 \text{ or } £\frac{91 \times 4}{\cancel{363}} \times \frac{\overset{50}{\cancel{18150}}}{1} \text{ or } £18{,}200$$

Now in the second stock

$$£97\tfrac{1}{2} \text{ produces } £3\tfrac{1}{2}$$
$$1 \quad ,, \quad £\tfrac{7}{195}$$
$$£18200 \quad ,, \quad £\frac{7}{\underset{3}{\cancel{195}}} \times \overset{280}{\cancel{18{,}200}}$$
$$= £\frac{1960}{3}$$
$$= £653\ 6s.\ 8d.$$

In the first stock

$$£90\tfrac{3}{4} \text{ produces } £3$$
$$£1 \quad ,, \quad £\tfrac{4}{121}$$
$$£18150 \quad ,, \quad £\frac{4}{\cancel{121}} \times \overset{150}{\cancel{18150}}$$
$$= £600$$

Hence there is an increase of £53 6s. 8d.

33. H. B. B., Abergavenny.—Any good Physical Geography would show you. It depends on longitude, of course. For instance, Paris is 2°20′23″ E. Long., and as the sun rises in the East and goes through the whole 360° degrees in a day of 24 hours, Paris has noon

$$\frac{2°20'23''}{360°} \times 24 \text{ hours before Greenwich,}$$

Or approximately, neglecting the seconds of angular measurement,

$$\frac{2\frac{1}{3}}{6} \times 24 \text{ minutes}$$

Or $\frac{28}{3}$ min., say $9\frac{1}{2}$, to make up for the 23″ neglected.

Thus, when noon at Greenwich, it is 11h. $50\frac{1}{2}$m. A.M. at Paris

34. Je ne sais pas, Lees.—You are very indefinite. You do not say whether you wish for an elementary or advanced book, whether you have done a course of Exercises or not, or whether you know any French worth speaking of.

Under the circumstances we cannot make you a better recommendation than Chardenat's *Advanced Exercises.*

35. T. A. Mummery, Folkestone.—The parallel sides of a trapezoid are respectively 16 and 20 feet, and the perpendicular distance between them is 5 feet. It is required to divide the trapezoid into two equal trapezoids. Find the distance of the dividing straight line from the shorter of the parallel sides. (Todhunter's *Mensuration.*)

Let ABCD be the trapezoid, DC being the longer side, and AE, BF be perpendiculars on DC from A and B, namely, E adjacent to D and F adjacent to C. Suppose the line that is to bisect the trapezoid cut AD, AE, BF, BC respectively in G, H, K, L.

$$\begin{aligned}
&\text{Let } AH = BK = x\\
&\text{Then } GH:AH::DE:AE\\
&\qquad GH:x\ ::DE:\ 5\\
&\text{Also } KL:x\ ::FC:\ 5\\
&\therefore GH+KL:x::DE+FC:5::20-16:5\\
&\qquad ::4:5\\
&\therefore GH+KL=\frac{4x}{5}
\end{aligned}$$

$$\text{But } HK=AB=16$$

$$\therefore GL=16+\frac{4x}{5}$$

$$\text{And area } GABL=\frac{x}{2}(AB+GL)$$

$$=\frac{x}{2}\left(32+\frac{4x}{5}\right)=x\left(16+\frac{2x}{5}\right)$$

But this area is half of the whole, *i.e.*,

$$=\tfrac{1}{2}(16+20)5=9\times5=45$$

$$\therefore x\left(16+\frac{2x}{5}\right)=45$$

$$2x^2+80x=225$$

$$2x^2+80x-225=0$$

$$x=\frac{-80+\sqrt{6400+1800}}{4}=\frac{-80+10\sqrt{82}}{4}$$

Now by tables $\log 82=1\cdot9138139$

$\log\sqrt{82}=\cdot9569069$

$\therefore \sqrt{82}=9\cdot0553$, etc.

$$\therefore x=\frac{10\cdot553}{4}=2\cdot638 \text{ feet.}$$

The negative root to the quadratic equation is, of course, irrelevant.

36. G. W. Kent, Leamington.—The receipts of a railway company are apportioned in the following manner:—49 per cent. for working expenses, 10 per cent. for the reserved fund, a guaranteed dividend of 5 per cent. on one-fifth of the capital, and the remainder, £40,000, for division among the holders of the rest of the stock, being a dividend at the rate of 4 per cent. per annum.

Find the capital and the receipts.

£40,000 is a dividend of 4 per cent. on $\frac{4}{5}$ of stock
£1,000,000 is 100 per cent. of $\frac{4}{5}$ of stock
i.e., is $\frac{4}{5}$ of stock
$\therefore$ Stock, or capital, is £1,250,000
On $\frac{1}{5}$ of this, *i.e.*, £250,000, 5 per cent. is paid.

$\therefore \frac{£250000}{20}$ or £12,500 is paid.

Hence receipts are apportioned thus
59 per cent. railway management
£52,500 being the remainder for dividends
$\therefore$ £52,500 is 41 per cent. of receipts.

$\therefore$ receipts are $\frac{£5,250,000}{41}$ which doubtless comes, as you say, to £128,048 15s. $7\frac{11}{41}$d.

37. Chelt, Sheffield.—Two planes, inclined at one-third and two-thirds of a right-angle to the horizon respectively, meet at the top and slope opposite ways. If bodies of equal weight fall down these planes, starting at the same instant, show that the motion of their centre of gravity is the same as if one of them were to remain at rest and the other to fall vertically. (Magnus' *Mechanics.*)

Consider the position of the bodies at any instant h after starting. Let us call the bodies A and B.

A has fallen $\frac{1}{2}(g \sin 30^\circ)h^2$ or $\frac{gh^2}{4}$

B " $\frac{1}{2}(g \sin 60^\circ)h^2$ or $\frac{gh^2}{4}\sqrt{3}$

Hence it will be seen at once that A is distant $\frac{gh^2}{4}\cdot\frac{\sqrt{3}}{2}$ from the bounding line of the planes, B $\frac{gh^2}{4}\cdot\frac{\sqrt{3}}{2}$ from the same line, *i.e.*, they are equidistant. Hence the centre of gravity is always in this line, *i.e.*, it falls vertically from the ridge of the planes.

Also, the vertical height through which A has fallen is $\frac{gh^2}{8}$ and the similar quantity for B is

$$\frac{3gh^2}{8} \text{ i.e. } \frac{gh^2}{4}.\sqrt{3}\times\frac{\sqrt{3}}{2}$$

$\therefore$ The centre of gravity has fallen through a vertical height $\dfrac{\frac{3gh^2}{8}+\frac{gh^2}{8}}{2}$ or $\frac{gh^2}{4}$ *i.e.*, just one-half the height that a body would fall freely in the time.

On referring to a figure it will be seen at once that this proves the proposition.

38. Hope, Surrey.—Collins has a *Dictionary of Synonyms* that would help you very much in parsing. Price 1s., remarkably cheap.

'She hesitated, and then blushing sang the first song which was to do honour to the stranger who had that day arrived. Her rich voice for a time kept to the rhythm of the tune, but then, bursting through all restraints, she sang and at the same time composed regular periods of verse.'

39. E. Cross, Faversham.—A person ascending vertically in a balloon lets fall a stone when at a given height ($=h$); find the time of the stone's reaching the ground, supposing the velocity of the balloon at the given altitude known ($=u$).

By ordinary formula

$$h=-ut+\tfrac{1}{2}gt^2$$

$$\therefore gt^2-2ut-2h=0$$

$$t=\frac{1}{g}\left\{u\pm\sqrt{u^2+2gh}\right\}$$

Evidently the + value is the right one, the minus corresponding to a problem of slightly different enunciation, but leading to the same algebraical equation. You will not find it hard to enunciate this. Wait till next time for your other.

40. W. R., Sandsling.—Referring to our former figure (query 7, May), you will see that by Euc. VI. 8, $AB.BC=BD^2$ $\therefore AB=\frac{BD^2}{BC}$ and BD and BC are both known, so that AB is known.

This method is perfectly fair even in a purely Arithmetical Paper. You cannot expect to do a problem in Arithmetical Geometry or Mensuration without using Geometry.

In our previous solution we introduced Algebra because we never like to pre-suppose a higher knowledge of Euclid than is really absolutely necessary for the solution of the problem.

41. Nemo, Leamington.—
Find the G. C. M. of $x^4-2x^3+x^2-8x+8$ and $4x^3-12x^2+9x-1$

$$\begin{array}{r|l|l}
4-12+9-1 & 4-8+4-32+32 & 1+1\\
 & 4-12+9-1 & \\
\hline
 & 4-5-31+32 & \\
 & 4-12+9-1 & \\
\hline
 & 7-40+33 &
\end{array}$$

Having now reduced one quantity to a quadratic function, we will finish the sum by factors.

$$7x^2-40x+33=(x-1)(7x-33)$$

Now $7x-33$ cannot divide $4x^3-12x^2+9x-1$

$\therefore x-1$ is G. C. M., if there is one at all, and it will be seen on inspection that $x-1$ divides both quantities.

42. A. E. S., Ealing.—The diameter of a square is the diagonal, not the width. It is a foolishly incorrect expression, if our opinion will comfort you.

43. Nero, Pontypridd.
Find a, b, c so that both $x^4+ax^3+bx^2+cx+1$ and $x^4+2ax^3+2bx^2+2cx+1$ are perfect squares.
(London, *First B.A.*, *Pass.*, 1881).

$$\text{Let } x^4+ax^3+bx^2+cx^3+1=(x^2+px+1)^2$$

$$=x^4+2px^3+(p^2+2)x^2+2px+1$$

$$\therefore a=c=2p \quad b=p^2+2=\frac{a^2}{4}+2$$

The condition that the second expression should be a perfect square is evidently got by substituting

$2a$ for a, $2b$ for b, $2c$ for c

and is $2b=a^2+2$

But they are simultaneously squares

$$\therefore\ 8 = \frac{a^2}{4} + 2$$
$$2b = a^2 + 2$$
$$2b = \frac{a^2}{2} + 4$$
$$\therefore\ \frac{a^2}{2} = 2 \quad a = \pm 2 \quad b = 3 \quad c = \pm 2$$

Hence there are two sets of values

$$\begin{Bmatrix} 2, & 3, & 2 \\ -2, & 3, & -2 \end{Bmatrix}$$

44. GILBERT.—No, a conjunction. Yes. Yes.

45. J. E. R., Sedgley.—There would seem to have been two Ermine Streets, and this fact will explain the discrepancy you name. The main and most important one ran from London to Lindum or Lincoln, and thence continued north to the great cap'tal at York or Eboracum. This is the description which Dr. Collier gives as quoted by you. Probably the road f om Pevensey, a natural landing-place for the Romans, to London was continuous with this, and might have been called by the same name. This gives rise to the second statement you quote. The other Ermine Street is more proper'y Irmin or Hermin Street, the second spelling being most correct. It ran, as the other two statements you quote say, from St. David's to Southampton. As to the former, its course is as well defined as any of the Roman roads, except Watling Street and Fosse Way. From Royston, a small village on G. N. R., midway between Hitchin and Cambridge, to Huntingdon it is the main coach road still, and a very good road it is. The name is Norse, for Cambridgeshire was the very centre of the Danish settlements in England during the ninth century. The original word is Eörme—bog earth. There is a small village on it called Ermingford, which, being interpreted, is the ford of the fen-m n. This shows at once the locality through which the road passed. Hermin, on the contrary, is a Latin name.

46. FRANK GASKIN, Leamington.—A man invested a sum of money in 4½ per cent. stock, standing at 1½ per cent. premium, and allowed the investment to accumulate at simple interest. The stock went down in value for 9 years at the average rate of ⅛ per cent., and then improved for 5 years at the rate of ¼ per cent., at the end of which time he was able to draw out £49,387 10s. od. What was the original sum?

Total increase of value in stock $-\frac{9}{8} + \frac{5}{4} = \frac{1}{8}$

∷ Selling value is $101\frac{1}{2} + \frac{1}{8} = 101\frac{5}{8}$

$\therefore$ Money increases by reason of investment $\frac{101\frac{5}{8}}{101\frac{1}{2}}$ times = $\frac{813}{812}$

Also the interest is 4½ % per annum.

$\therefore$ 14 × 4½ % for 14 years.

i.e., 63 %

$\therefore$ Money is now $\frac{163}{100}$ of what it was

∴ The original sum was $\frac{100}{163} \times \frac{812}{813} \times 49387\frac{1}{2}$

$$\text{This is } \frac{£100}{163} \times \frac{\overset{406}{\cancel{812}}}{813} \times \frac{98775}{\cancel{2}} = £[illegible]$$

$= £30,261$ 16s. 4d. nearly.

47. ELIAS T. JONES, Chevilog.—There is no difficulty in your sum, but we cannot spare space, as all such are clum y to write down. Your best plan, if you really cannot manage it, is the following: draw a straight line about 14½ in. long, to represent distance from New York to San Francisco. Figure New York trains by a cross bar in red ink, San Francisco trains being in black. Take 1 in. to represent their day's journey and divide your line into inches, beginning at each end. You will have no difficulty then in seeing how to work the problem.

48. X. Y. Z., Mossley, and 'A SUBSCRIBER,' Nottingham.—We do not at present see solutions to your problems depending on the particular propositions by which you wish them to be proved, but we will try to let you have them by next month. Of course they are both easily worked by other propositions.

—o—

Scholarship Examination, 1881.

MALE AND FEMALE CANDIDATES.

Music.

Thr.e hours allowed for this and the School Managem.nt Pap.r.

The Tonic Sol-fa questions are printed in Italics. Candidates must keep *entirely* to one set of questions or the other *They are not pe mitted to answer more than* FOUR *questions.*

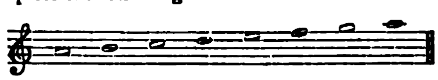
1. Write *over* each of the following notes its pitch name (A, B, *Do*, *Re*, or other); *under* it, its duration name (Crotchet, Quaver, or other); and *after* it, its corresponding rest.

1. *Write* OVER *each of the following no'es its name with regard to its position in the scale, third, fifth, or o'her; and* UNDER *each the time names for notes and rests.*

KEY C.

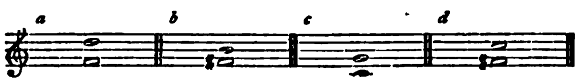
{| f :— | d : | l : | m' :
{| s_1 :— | r_1 : | f :— | r .

2. Complete the following as a scale of A or *La*.



2. *Write a scale in the Lah mode; and one in the Ray mode.*

3. Write under each of the following pairs of notes its name (second, third, or other), and quality (major, perfect or other).

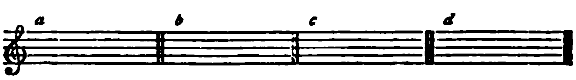


3. *Write under each of the following pairs of notes, its name (second, third, or other), and quality (major, perf.ct or other).*

KEY C.

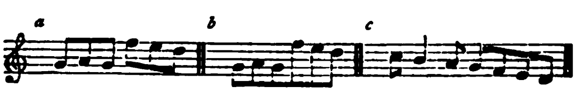
	a	b	c	d
	r' :	t :	s :	d' :
	f :	fe :	d :	fe :

4. Write in *a* the signature of D (*Re*); in *b* that of G (*Sol*); in *c* that of F (*Fa*); and in *d* that of B (*Se*).

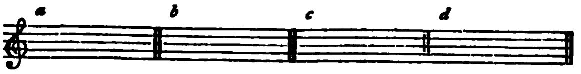


4. *Write the names of the respective Dohs when La is B, D, and G; and the names of the Lahs in Keys D, F, and B flat.*

5. Place time signatures before each of the following passages.



5. *Write a phrase in three-pulse measure, a phrase in four-pulse measure in secondary form, and a phrase in six-pulse measure, with one or two silent pulses.*



6. Write the scale of E (*Mi*) minor, descending and ascending.

6. *Write the upper part of the scale in the minor mode, ascending or descending, in all the forms with which you are acquainted.*

ANSWERS.—SCHOLARSHIP EXAMINATION.

1. F. C. A. E.

Minim. Quaver. Crotchet. Semibreve.

G. D. F. F.

Crotchet. Quaver. Semibreve. Crotchet.

1\. Fourth. Tonic. Sixth. Third.

KEY C. Upper.

{ | f :— | d : | l : | m' : |

Time names for notes. Traa-ai- aa-ai- Traa-ai. do. Traa-ai- aa-ai.

Time names for rests. Shaa-ai. do.

Fifth. Second. Fourth. Second.

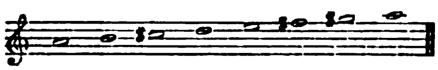
Lower. Lower.

{ | s_1 :— | r_1 : | f :— | r : ||

do. Traa-ai. Traa-ai - aa-ai. Traa-ai.

Shaa-ai. Shaa-ai.

2\.



2\.

Ancient Lah Mode.	L	T	D	R	M	F	S	L	
Modern Lah Mode.	L	T	D	R	M	Bah	Se	L	
Ray Mode.		R	M	F	S	L	T	D	R

or,

Ancient.	Modern.	
L	L	R
S	Se	D
F	Bah	T
M	M	L
R	R	S
D	D	F
T	T	M
L	L	R

3\. a b c d

Major Sixth. Perfect Fourth. Perfect Fifth. Diminished or Imperfect Fifth.

3\.

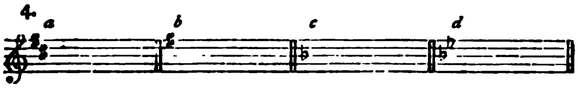
KEY C.

a b c d

{ | r' : | t : | s : | d' : ||
{ | f : | fe : | d : | fe : ||

Major Sixth. Perfect Fourth. Perfect Fifth. Diminished or Imperfect Fifth.

4\. a b c d



4\. Lah B : Doh D | Key D Lah is B
„ D : „ F | „ F „ D
„ G : „ B♭ | „ B♭ „ G

5\. a b c

Syncopated.

5\.

Three-pulse measure.

{ | d :r :m | d :m :f | s :m :d ||

Four-pulse measure, Secondary form.

{ :d | m :s | m :d | m :r | d : || s :m :d | r :-: | f :m :r | m :-: ||

6\.

6\.

Ascending.				Descending.
Old L	Modern	L	L	L
S		Se (s)	Se (s)	S
F		Ba (F)	F	F
M		M	M	M

School Management.

MALE AND FEMALE CANDIDATES.

Three hours allowed for this Paper with that on Music.

Those who are or have been Pupil Teachers are not to answer more than one question in any Section. Candidates who have not been Pupil Teachers may answer any *seven* questions they think fit, except in Section I., from which only one subject may be selected for notes of a lesson.

No Candidate is to answer more than *seven* questions.

Section I.

Write full notes of a lesson on *one* of the following subjects:—

(1) Animals of the cat kind.
(2) Cardinal Wolsey.
(3) The river Mississippi.
(4) The manufacture of a cup, *or* a needle, *or* a boot.

Section II.

1\. Why should young teachers be restricted from the use of corporal punishment (*a*) for the sake of their scholars? (*b*) for their own sake?

2\. What bad habits are produced by careless correction of exercises, and by want of attention to home lessons?

3\. Point out some of the ways in which school discipline may be useful in producing habits of ready obedience, and name some characteristic features of good discipline.

Section III.

1\. Enumerate Froebel's seven gifts, and show the progressive nature of their lessons.

2\. For what purposes are lessons on Form and Colour given to infants? Name the order in which the principal plane figures should be taught.

3\. Write out some sentences containing five or six words which would present difficulties to each of the three lowest standards, and explain the progressive character of your method.

Section IV.

1\. Select from the following passage words of irregular notation, and point out the irregularities:—

When I met a man of pleasure, sacrificing every laudable improvement of mind, or of fortune, to mere sensual gratification; 'Mistaken man!' said I, 'you are providing pain for yourself, instead of pleasure; you give too much for your whistle.'

If I see one fond of fine clothes, fine furniture, fine equipages, all above his fortune, and for which he contracts debts, and ends his career in prison; 'Alas!' I say, 'he has paid dear, very dear for his whistle.'

2\. Describe a ball frame for teaching arithmetic, and show how it can be employed in teaching Short Division with or without remainders.

3\. Write at full length an example in Compound Practice which will prove your process in this instance to be shorter than the ordinary method of Compound Multiplication.

Section V.

1\. Show that a map differs from a picture, and explain how you would supply its dificiencies to a class beginning to learn Geography.

2\. Explain how time may be economised in teaching Needlework by the use of the blackboard and other class apparatus.

3\. Distinguish the uses of dictation and transcription lessons for children lately transferred from an infant school.

Section VI.

1\. Write out brief notes of a lesson on 'Glass,' and explain your purpose in teaching the names of its qualities.

2\. Make out a list of lessons on 'Common things,' illustrative of the pressure of the atmosphere, and give brief heads of *one* of such lessons.

3\. Select points in the character of Lady Jane Grey, *or* Robert Bruce, *or* Nelson, that would be especially attractive to children, and write out some anecdote by which you would illustrate each point.

SECTION VII.

1. What directions would you give for the daily and weekly cleaning of a schoolroom? What additional cleaning is needed at longer intervals?

2. Show that, for some lessons, infant classes should be smaller in number than classes composed of older children, and that, for other lessons, one or more classes may be grouped.

ANSWERS.—SCHOOL MANAGEMENT.

SECTION I.

(1) Animals of the Cat kind.

I. PRINCIPAL VARIETIES.—Lion, tiger, leopard, panther, jaguar, wild cat, domestic cat. These include many of most powerful of the *Carnivora*, or flesh-eating tribe of animals.

II. STRUCTURE.—Specially adapted to suit their mode of life. A combination of strength, lightness, and agility. Bones, muscles, feet, claws, teeth, tongue, whiskers, eyes, and ears equally adapted to necessities of the animal.

(*a*) *Bones:* Of great strength, necessary for rapid movements of body; those of skull and vertebræ particularly so, for attachment of muscles and so as to resist shocks the animal might receive in leaps, etc.

(*b*) *Muscles:* Very hard and tough, turning edge of sharpest knife.

(*c*) *Feet and claws:* Feet provided with pads, enabling them noiselessly to approach prey. When resting on ground, claws enclosed in sheath; when stretched out, protrude, and are *long*, *sharp*, and strongly *curved*. (Draw diagram.) Claws protected when animal is walking; thus always sharp for seizing prey.

(*d*) *Teeth:* Formed only for biting and tearing, not chewing, having no flat surface necessary for grinding food.

(*e*) *Tongue:* Dry, rough; points turned backward. Can scrape every particle from bones of prey.

(*f*) *Whiskers:* Exactly same width as body; connected with sensitive nerves at base. Slightest touch enables animal to feel.

(*g*) *Eyes:* Large, round; pupil capable of great expansion, necessary at night.

(*h*) *Ears:* Movable, so as to incline towards prey in front, and foes behind.

III. HABITS AND CHARACTER.—Vary in different animals. Generally courageous, fierce, cunning, indolent, cautious, wary; torment prey; can be tamed. Come upon prey noiselessly; strike suddenly. Seek prey at night.

IV. DISTRIBUTION.—Some kind found in every continent except Australia. If time allow, name district of each.

(2) Cardinal Wolsey.

BIRTH AND EDUCATION.—Said by some accounts to have been son of a butcher; by others, of a private gentleman, of Ipswich. Born in 1471. Educated at Magdalen College, Oxford, graduating B.A. in 1486. Took orders and was appointed to rectory of Lymington, and made one of Henry VII.'s domestic chaplains in 1505.

HIS RISE AND GREATNESS.—Henry employed him in several delicate negotiations, especially in matter of marriage with Maximilian's daughter. He became successively Bishop of Tournay, 1513; Bishop of Lincoln, 1514; Archbishop of York, 1514. In 1515 he became Chancellor, holding the abbacy of St. Alban's, the bishopric of Durham and of Winchester, besides being made a cardinal and papal legate. His duties were performed with such ability that he became a great favourite with Henry VIII., and obtained even the applause of his enemies. He acquired great influence over the king, and succeeded in amassing great wealth, ostentatiously displaying it and provoking the envy of others. He aimed at becoming pope, but his efforts were twice frustrated.

HIS FALL.—He at first favoured Henry's design of divorce from Catherine; but when Anne Boleyn was chosen by the king to fill her place, his ardour cooled, and the king gradually lost patience with his favourite. The excessive taxation for the French wars, the haughtiness of his demeanour, and his inquisitional authority in matters of conscience had weaned the affections of the people. Every effort was made to secure his downfall, and listening to suggestions of his enemies, Henry caused Wolsey to be impeached, and to give up the great seal. Was banished to Esher, but afterwards allowed to retire to York.

HIS DEATH.—Was arrested in the winter of 1530 on a charge of treason, conveyed towards London; died at Leicester Abbey, 29th November. (Repeat his last words.)

HIS CHARACTER.—Ruling principle, ambition; proud, haughty, unscrupulous, ostentatious in display of wealth, a friend of education, and patron to men of science, literature, and the arts.

(3) River Mississippi.

Show on map, draw on blackboard as description is being given.

I. INTRODUCTION.—Note general direction and character of rivers in North America owing to position of mountain ranges. Mississippi, with Missouri, longest river in North America.

II. SOURCE.—Only 1500 ft. above level of sea. Rises in Lake Itaska, in State of Minnesota.

III. LENGTH AND COURSE.—2400 miles long; flows in southerly direction through splendid, well-wooded, well-cultivated valley or plain into Gulf of Mexico, passing through States of Minnesota and Iowa, and separating Missouri, Arkansas, Louisiana from Wisconsin, Illinois, Kentucky, Tennessee, and Mississippi.

Receives Missouri (2500 miles long), Arkansas, and Red Rivers on right bank; and Ohio, Wabash, Cumberland, and Tennessee on left.

Is navigable through whole of course, except 400 miles; from source of Missouri to mouth nearly 4000 miles. Delta at mouth laid under water, immense swampy tracts being formed.

IV. TOWNS ON BANKS.—Starting from source. *St. Paul*, limit of navigation, owing to falls of St. Anthony; *St. Louis*, at junction of Mississippi and Missouri, lumber and wheat trade, rival to Chicago; *Memphis*, cotton, rice, maize; *Vicksburg*, strongly fortified; *New Orleans*, great trade, next to New York, exports great quantities of cotton and other produce of Mississippi Valley.

On Missouri, *Jefferson City*, with oil springs.

On Ohio, *Pittsburg*, centre of coal and iron industries; *Cincinnati*, largest town in Western States, great trade.

(4) Manufacture of a Cup.

I. MATERIALS EMPLOYED.—Clay and flint. For finer kinds of earthenware a description known as *China clay*, found in large quantities in Cornwall, and being felspar in a partly decomposed state, is largely used, together with *steatite*, or soapstone, a species of mica found in Anglesea, calcined bones, and gypsum. Some makers use other ingredients.

II. PREPARATION AND MANUFACTURE.—Clay mixed with water thoroughly till of the consistency of cream, one pint weighing 26 ounces; operation called *blunging*.

Flints burnt to increase brittleness, rubbed against each other, and ground to fine powder in vat by rollers of felspar. After being further refined, flint, etc., mixed with clay, quantities of each varying according to article required, and ideas of manufacturer.

Mixture called *slip*; superfluous water removed in slip kiln; air-bubbles removed by *wedging* and *slapping*. (Explain.) Ready for *throwing*. Potter places piece of clay on wheel, and by means of foot turns wheel; forms cup with hand. Handle made and attached after turner has cut the cup to proper thickness. Now partly baked, called *biscuit*; glazed, painted, gilded, and rebaked. Common patterns applied from paper impression, finer kinds hand-painted.

III. WHERE MANUFACTURED.—North Staffordshire, Potteries, Stoke, Hanley, Burslem, Chelsea, Derby, and Worcester.

(4*b*) A Needle.

I. MATERIAL.—Soft steel wire procured from steel works at Sheffield or Birmingham, made in coils of great length.

II. MANUFACTURE.—Wire cut into pieces from two to four inches in length, called *ends*, sufficient to make two needles.

Made into bundles, heated and straightened. Next ground at both ends; points formed. Stamped, and groove made in which to place eyes. Eyes pierced by hand-presses worked by boys. Needles cut in two, and heads filed to proper shape. The bent needles are now straightened by being rolled between iron plates, and hardened by being heated and then suddenly cooled in water. Well scoured in loose bundles, in oil, emery, soap, and polishing putty; eyes drilled and points finished; finally polished and papered.

III. WHERE MANUFACTURED.—Redditch (Worcestershire), Gloucester, Whitechapel (London), Hathersage (Derby). Nearly 80,000,000 needles made at Redditch alone every week.

IV. LESSONS TO BE LEARNT.—Value of division of labour. Impossibility of one man performing all processes required in manufacture of such a small thing as a needle, over 100 hands being required in its economical manufacture.

(4c) A Boot.

I. Materials Employed.—Leather of different kinds according to quality or sort of boot required (calf's skin, cow-hide, kid, morocco). Nails for heavy work.

II. Manufacture.—By hand or machinery. Skins having been properly tanned and curried by the tanner and currier, the shoemaker cuts out the *tops* or upper part of the boots, and fastens the leather thus cut to a last—a piece of wood of the same shape as a foot. Round the lower edge of this top a strip of leather called a *welt* is sewn, and to this *welt* the sole of the boot is either sewn with waxed threads or pegged with brass nails. Two or three layers of leather are added to raise the heel, an inside sole is added, and the outside polished; *eyes* are added if laces are to be used. In the sole nails are hammered if the boots are needed for hard usage.

III. Places of Manufacture.—Leeds, Leicester, Nottingham, London, Stafford, and Wellingborough. Very fine kinds are imported from Paris.

IV. Remarks.—Compare with ancient boots, and with modern covering for the feet used by some nations on the Continent, and give statistics of manufacture.

Section II.

1. (*a*) Children dislike punishment. If punished by a young teacher, they dislike him, and prove more intractable than before. They are aware that punishment by pupil teachers is against the laws of the school, and if this law is transgressed they are rendered still more obdurate, evil passions are roused, and their sense of respect for law and order is weakened. Resistance to punishment by pupil teachers may also end in physical injuries to the children.

(*b*) Because it is not their province. The head teacher only is placed *in loco parentis*. If allowed to punish, young teachers, finding this method the easiest, the readiest to hand, would forget the proper end of punishment, their finer feelings would become blunted, and a tendency to give way to passion would be fostered. Young teachers have not had sufficient experience to enable them to determine accurately what amount of punishment should be given, and defiance of their authority would possibly lead them to give more than was necessary, and they would become amenable to the law of the land. Their influence over the children would be weakened if permitted to give corporal punishment.

2. If exercises are carelessly corrected, children become careless in their preparation; the writing becomes slovenly, the books dirty, and untidiness generally will be observable in the children; faults in spelling become rooted, and habits of inattention are fostered.

Home lessons serve as a means of testing the success of the lessons of the previous day. If no attention is paid to the home work, a teacher is less able to tell the individual progress of each child. Finding that his home tasks are carelessly examined, a lad thinks that '*anyhow*' will do if they are done at all. Want of neatness, inaccuracy, and inattention during the day are direct results of carelessness respecting home lessons.

3. Some of the characteristics of good discipline are order, attention, diligence, prompt obedience, regularity, punctuality, respect for the feelings of others, and subordination. School discipline requires that prompt and willing obedience should be given to orders given by the teachers. As it is necessary that this should be insisted on, obedience becomes a habit with children. The feeling of ignorance, and of sympathy with its associates, leads a child to act as they act, and a command given to all is readily obeyed. Appeals, too, in the lessons given in school, are made to a child's sense of duty, and habits of obedience are fostered by the child's belief that what is required of it is right. Where the sense of duty is wanting, fear of punishment, or the hope of reward acts as an incentive to obedience. Fear of punishment, hope of reward, habit, appeals to sense of duty are some of the 'ways' in which school discipline is useful for the purpose of promoting habits of obedience.

Section III.

1. *First Gift.*—The soft ball. (A box containing six coloured balls, three primary, three secondary colours.)

Second Gift.—Ball—cube, and cylinder, the ball being uncoloured and hard.

Third Gift.—The cube divided once in every direction—that is, into eight smaller cubes.

Fourth Gift.—A cube divided into eight oblong planes.

Fifth Gift.—An extension of the third gift, the cube being divided into twenty-seven cubes; three of these are further subdivided into halves, and three into quarters.

Sixth Gift.—An extension of the fourth gift. Cube divided into thirty-six pieces, eighteen being similar, six being the same length and thickness but only half the breadth, and twelve the same breadth and thickness, but only half the length.

Seventh Gift.—Box containing pieces of board cut in different forms.

The ball is taken first as being best calculated to develop the faculties of a child, eyes, ears, and limbs being necessary to follow its movements; the second gift introduces the simplest form of figures with surfaces, the others follow with other figures which can be produced from one or other of those which have preceded, the more complex forms coming last.

2. Lessons on colour and form are given to children in order to train both their perceptive and intellectual faculties, to enable them to form correct impressions of things about them, and ultimately to represent things which have come under their observation. Lessons on form are a good introduction to the arts of writing and drawing. Lessons on colour to cultivate taste after teaching to discriminate the commonly occurring colours.

Square, oblong, and other four-sided figures.
Triangles of different kinds.
Figures with more than four sides.
Circle and other curved figures.

3. The difficulties experienced by children in respect to words in the three lowest standards arise from the fact that the English language has fewer signs than sounds. Consequently the same sign represents different sounds, and similar sounds are often represented by different signs. It has also signs which are not needed, and many words have letters which are silent. These difficulties should be introduced more sparingly in the first than in the second, and in the second than in the third standard.

The following sentences contain words which present difficulties to the three standards respectively:—

I. The lion is a cruel, *fierce beast*. He is sly and cunning. He *creeps* behind a bush, then crouches down, and springs on his *prey*. His *roar* is very terrible.

II. *Though* I walk *through* the valley and shadow of death I will fear no evil. He was compelled to *bow* his head as he went under the *bough* of the tree, which stood where the roads *were* narrowed very much.

III. I *advised* him to get the *advice* of a *physician* who lived in the *neighbouring* town, but he *preferred* to *accept* the advice of another.

Section IV.

1. Pleasure, instead. Taking *ĕ* as the name-sound for *ea*, these words are irregular.

Improvement, above: sound of *o* is irregular.

Said, pain, paid, say: diphthongs having no sound of their own, first taking *ĕ*, and others *ā*.

Whistle: *tle* having sound of *l*.

Debts: *b* silent.

One: sound of *o* irregular

Sensual: *su* sounded like *shoo*.

Career, dear: *ee* and *ea* irregular, having sound of *ē*.

Pleasure, laudable, fortune, mere, are, whi tle, fine, on account of silent *e*.

Gratification: sound of *tion*.

2. A ball frame is a frame of wood with wires running from side to side parallel with each other and the top and bottom of the frame at regular distances. Coloured beads in sections of three are placed on each of these wires, the frame generally being a little more than twice the width of that portion of the wires which is covered by beads, so as to allow the beads to be moved backwards and forwards. The colours are so arranged that no two wires shall have the same coloured beads directly underneath each other. The wires are generally twelve in number, and there are twelve beads on each wire.

Any number of beads may be counted out on the frame. These may then be subdivided into groups of two, three, or more, as desired, and if the divisor is contained an equal number of times there will be no remainder. If numbers are chosen which have no factors, then it will follow that the division cannot be equally performed, and there will be remainders.

3. Find the value of 235 acres 2 roods 20 poles, @ 12s. 6d. per rood.

Practice.

	a.	r.	p.
	235	2	20
	4		
	942½ r.		

At £1 each, 942½ would

	£	s.	d.
	= 942	10	0
@ 10s. ½ (value at £1)	471	5	0
@ 2s. 6d. ¼ (value at 10s.)	117	16	3
	£589	1	3

Compound Multiplication.

	a.	r.	p.
	235	2	20
	4		
	942½ r.		
	£	s.	d.
½	0	12	6×2×942½
			10
	6	5	4×4
			10
	62	10	0
			9
	562	10	0
	25	0	0
	1	5	0
	0	6	3
	£589	1	3

SECTION V.

1. A map represents a portion of the earth's surface as seen from *above*. In ordinary maps therefore it is impossible to give correct representations of mountains and valleys, etc.

A picture represents an object, or series of objects, as seen *before* the eye.

To give scholars correct ideas of a map, plans of school, street, town, should be drawn on a flat surface *below* the eye. They will then see that, looking from above, the tables, forms, and desks appear to have no height, and can only be represented by the shape of their tops.

A box of moist sand should then be spread on a white sheet of paper below the level of their eyes. With this, shapes of countries, mountains, valleys, streams and lakes may be made, the paper representing the water, and the sand the land. Looked at from above, the mountains will appear to be without height, the streams will be but crooked lines, and the bays so many indentations in the land.

Practice has shown these methods very valuable in giving children correct ideas of what a map is designed to show.

2. The blackboard and other class apparatus can be used to economise time in teaching sewing, in cutting out, marking, and making different kinds of stitches. Instead of placing patterns before children, and giving garments to be cut from them, a whole class may be set to work at once by drawing a pattern on the blackboard, and writing the dimensions of the garment along the lines. The blackboard may also be used for showing the different kinds of stitches, and the necessity for their regularity and evenness.

Different patterns of Swiss darning, after the fashion of kindergarten work, and letters printed in different colours on different kinds of material, can be placed before a class so as to permit all to see and be engaged on the same kind of work at once.

3. Children lately transferred from an infant school have hitherto been engaged principally in the formation of individual letters, and these are numerous enough to require constant repetition to secure their retention. Combinations have been made from a copy in a teacher's handwriting, written on the blackboard. Another step must now be taken and these combinations must be made from printed characters or from memory. But their knowledge of words is limited; and their knowledge of the signs or letters representing these words is still more limited. Hence it is necessary that the printed characters should be placed before them, in order that they may become perfectly familiar with the written as well as printed characters representing the sounds. Transcription exercises ought therefore to be much more frequently given than dictation, the latter being introduced gradually as the familiarity of the children with words increases. The dictation lessons will be given principally to test the memory, and as a means of judging of the orthography of the children, and the transcription lessons as a means of testing the handwriting.

SECTION VI.

(1) Notes of Lesson on "Glass."

I. WHAT IT IS.—Mixture of sand or flint alkali (soda or potash) and lime (nitre, lead, borax, arsenic, also used for different kinds) made transparent by fusion. (Explain.)

II. HOW MANUFACTURED.—Sand and alkali mixed, burnt in furnace; cleared over a second furnace. Blower takes some out on tube, rolls it, blows it. It is then heated and allowed to cool very gradually (annealing). For plate glass, metal poured on table with raised edges, rolled and annealed.

III. QUALITIES.—(*a*) Transparent, (*b*) smooth, (*c*) brittle, (*d*) fusible.

IV. KINDS.—Flint or crystal glass, plate, crown (best window); broad (coarse window), bottle (commonest).

V. USES.—Windows, ornaments, optical instruments, household requisites; large buildings (Crystal Palace).

VI. PLACE OF MANUFACTURE.—Newcastle-on Tyne, South Shields, St. Helen's, Warrington, Birmingham, Leeds, Berlin, Bohemia.

To train to habits of observation, and to trace the relationship between the qualities of things and the uses to which they are applied.

2. Barometer, common sucker, common pump, diving-bell.

Common Pump.

I. INTRODUCTION.—Necessity for water. How supplied: Tap, rain-barrel, spring, pump.

II. PRINCIPLE.—Illustration: Tumbler placed upside down in water, filled; water remains in tumbler: why? Pressure of atmosphere. Mention barometer. Quicksilver supported at height of 30 inches; water lighter than mercury, supported at height of 33 feet.

III. CONSTRUCTION.—(Draw on blackboard; show model if possible.) Pipe, lower end in water, upper end covered; small door (valve) opening upwards into a box; piston (explain) in which is another valve; moved up and down by handle; spout above piston.

IV. METHOD OF ACTION.—Piston airtight; when raised, air above lifted out; air below raises lower valve to fill its place; piston moves down, upper valve opens, and on again being raised more air removed till ultimately water is raised and flows out of spout. Explain failure of action in summer. Valves shrink, expand on being soaked in water.

V. USE.—To raise water for various purposes; to fill traction engines, etc.

(3a) Lady Jane Grey.

(*a*) Modesty; (*b*) learning; (*c*) piety.

(*a*) When told of the death of Edward, and that she had been proclaimed Queen, she fainted, and on her recovery expressed the greatest reluctance to occupy a place for which, *she* said, she was unqualified by nature and education.

(*b*) Roger Ascham, the schoolmaster, once paid a visit to her house and found her reading *Plato*, while all the rest of the family were hunting in the park. Two lines of Latin poetry were found scratched on the walls of her prison after her execution.

(*c*) When her husband wished to see her on the day of their execution, she refused, fearing it would unnerve them for their death, saying their separation would only be for a few moments, and they would soon meet where death, disappointment, and misfortunes would never mar their felicity.

Fuller says: 'She had the birth of a princess, the learning of a divine, the innocency of childhood, the life of a saint, and yet suffered the death of a malefactor for the offences of her parents.'

(b) Robert Bruce.

Bravery and patriotism; courage under difficulties; devotion.

BRAVERY AND PATRIOTISM.—When Edward seemed to have thoroughly succeeded in conquering Scotland, and Bruce's country seemed to have no friend, the love he had for it roused all his energies. Although repeatedly compelled to flee from

his enemies, in the Battle of Bannockburn he succeeded in almost completely destroying the power of Edward. In this he was always in the thickest of the fight, and the first knight killed in the English army was killed by him.

COURAGE UNDER DIFFICULTIES.—After repeated failures, he hid in the island of Arran. Although almost despairing he was encouraged by the success of the spider in reaching its home. Deceived by a false signal, he nevertheless attacked the castle of Temberry, and took it, this being the beginning of his successes against the English.

DEVOTION.—Before commencing the Battle of Bannockburn he himself set the example to his soldiers of kneeling in prayer and asking for aid for his countrymen.

When he was dying, he desired one of his knights to promise to convey his heart to the Holy Land, in confirmation of his desire to fulfil a vow he had made should he be able to secure peace for his kingdom.

(c) Nelson.

Bravery; honour; patriotism.

BRAVERY.—As a *child*, wandered from grandmother's house after birds' nests; when found, and asked if he were not afraid, said: 'Fear never came near me.'

As a *boy at school*, succeeded in getting pears from a tree in a dangerous position, and said: '*I only got them because every other boy was afraid*.'

As a *midshipman*, went to catch a bear with a shipmate. When his gun missed fire, although in imminent danger of losing his life, he said: 'Never mind; only let me get a blow at him with the butt end, and we shall have him.'

HONOUR.—His brother William and he were sent to school. William was anxious to stay at home, and reported that the snow was too deep. 'Make another attempt,' said the father, 'and if you cannot get there, come back; but remember, I leave it to your honour.' Difficulties presented themselves, and William cited these as excuses for returning home; but Horatio was proof against them all, exclaiming: 'We have no excuse; remember, it was left to our honour.'

PATRIOTISM.—All Nelson's subsequent career was an illustration of the above qualities and his love of his country.

After the sieges of Calvi and Basti, in 1793, although he had been engaged four months, displaying splendid military talents, his services went unrewarded; and although he felt justice had not been done to him, he continued to place his services at the disposal of his country, gaining afterwards numerous victories for her in different parts of the world.

SECTION VII.

(1) *Daily*.—As soon as the children are dismissed, open all the windows, strew slightly-damped sawdust upon the floor, and sweep thoroughly. When the dust caused by sweeping has had time to settle, dust properly all furniture and apparatus.

In winter-time, clear away all ashes, brush the grate or stove, lay fire for following morning, and wash the hearth in addition to above.

Weekly.—Before commencing to sweep use wall-brush to take away cobwebs and dust accumulated during the week, and wash windows outside and inside. The floor should also be washed at regular intervals—in some cases every week; in others, every fortnight or three weeks would suffice.

At longer intervals (during the Midsummer holidays is a convenient time) the walls should be whitewashed, or if painted, washed; the woodwork should be cleaned, and if necessary, varnished or painted; the desks also, and all the apparatus, such as blackboards, easels, etc., thoroughly cleaned. The painting should be renewed as required, at longer or shorter intervals, ac or l ng to the nature of the district in which the school is situated.

(2) Young children are naturally more restless than those who are older. It is therefore more difficult to retain their attention, unless each individual has continuously something to do. In all lessons, therefore, where much individual practice without imitation is essential, the classes should be smaller than in schools containing older children, in order that each may the oftener be employed. Reading and arithmetic lessons are of this character. Sewing also, and kinder-garten work can only be taught to individuals or small classes. On the other hand, writing, singing, object lessons, and marching can be taught to large numbers, the attention of the children being concentrated principally upon the teacher's words and actions.

[We are again compelled to hold over a portion of the Scholarship Questions till our next issue.]

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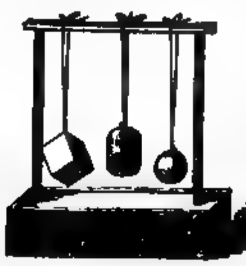

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Health at School.

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Vice-President of the British Medical Association.

IX.—DORMITORIES.

IT is now necessary to make a few suggestions upon the subject of Dormitories. It is one which is closely related to that of warming and ventilation, and cannot be left out of our work without making a gap in it. Health at School is intimately associated with bed-room accommodation in those schools which lodge the pupils, and which are usually called boarding-schools. This chapter will, of course, be applicable only to this class, and scarcely form part of the instruction to elementary schools. To the former class, a consideration of the sleeping accommodation, which is or ought to be provided, is the most important part of school hygiene.

There are different plans of arrangements in different classes of schools. In one kind the study and the dormitory are combined; this is a bad arrangement, and should not be tolerated. There is something more to be considered in this part of our work than pure air and simple sleeping accommodation. The morals of a school are closely connected with the character of the bedroom arrangements, and nothing tends so much to debase a bad boy's mind as the knowledge of the fact that he cannot be quietly supervised when at his work: that the master cannot see him without the boy himself knowing of the supervision. The knowledge is not injurious to the good boy, but the bad boy is sure to take advantage of it, and it will encourage the formation of habits which are never thrown off again if once indulged in. Study in the day-time should not be permitted in the bed-room. It has a tendency to make the air impure in spite of ventilation, and it allows of customs which will be indulged in, in the night as well as in the day-time. It leads the student to work at night, to keep awake when he ought to be asleep, and thus to alter the law of nature. The bedroom is for rest and sleeping, not for recreation or study. This is a rule which must not be departed from for if children get into the habit of reading in bed, or when they ought to be in bed, it is certain to interfere with their proper rest, and deprive them of some of that repair which the nervous system requires, and which is best obtained when the sun is below the horizon.

The next objectionable plan, at any rate for little children, is that in which the dormitory is divided into a number of compartments, which are sometimes called kennels, more usually cubicles. These have also the disadvantage of not being capable of easy supervision. It is the best kind of arrangement for young men and young women if the partitions are simple, not complete, and if they are used for the purpose of privacy, but not sufficient to impede ventilation; but boys and girls under fourteen do not want privacy, and cubicles are not advisable until puberty is approaching. The partitions should only be about five feet high, or not more than half the entire height of the room, and should not touch the floor of the room except at points for support; there should be a few inches of space between the partitions and the floor. They should be capable of removal for cleansing purposes, and in the holidays should be taken down and washed if they are wooden, whilst if they are canvas or linen, they should be properly disinfected by washing or heating and exposure to the open air for a few days before being put back again.

The number of kennels in any given room should never exceed from ten to twenty—twelve is a good number. They should occupy each side with a passage between the two rows of beds, and if possible there should be a window between each two beds. Care should be specially observed that the windows should open top and bottom. There should be at least half as many windows as there are beds in the room, and the windows should each be within a few inches of the ceiling. There should never be more than two rows of beds in any one dormitory. These arrangements apply whether there are cubicles or not. Large dormitories are not satisfactory. I know of some containing forty beds. There are serious objections to large rooms. If a case of infectious disease shews itself, it is usually in the morning when it is discovered, and all the children who have slept in the same dormitory are, or ought to be, necessarily put into quarantine, and the larger the dormitory the more difficult this is to accomplish. I prefer at the most from twelve to twenty beds. From a sanitary point of view, the open dormitory is better than the cubicle; for young children it is also morally better, so that

the teacher may be able to see the whole of the children at one glance, but as they grow up into young men and young women, they should be allowed privacy by means of cubicles. Evil habits are learnt most certainly in very early life, and vicious practices will not be so likely to be indulged in after fourteen if they have not been learnt before. No doubt the majority of children are opposed to vice, and it will not be openly indulged in in a dormitory. There ought to be a standing rule also, which the tutor should take care to have completely observed, viz., that no boy or girl should be allowed to go into another's cubicle on any kind of pretence; vicious habits will then be reduced to a minimum, and be restricted to a very small class, even in the largest schools. These habits very often have their origin in nerve irritation, and are a consequence of disease in the first instance, and if a boy is not allowed to impart his tendencies to others who are not diseased, the mischief is stopped in the bud, whilst if it is not checked in this manner, much harm may result from its propagation, and the morals of a given school be utterly ruined by one or two vicious or irritable boys. This cannot arise in a well-ordered school in which the dormitories are properly supervised, and the children not allowed to visit each other whilst in bed, or to frequent each other's cubicles. I urge this as a most important part of school management. If fairly carried out it may be the means of saving many a child from becoming an inmate of a lunatic asylum later in life.

The largest part of the pupils' time is spent in the bedroom; it is very necessary that the air should be kept pure, and that the room should not be overcrowded. School bedrooms should be at least twelve feet in height, and twenty feet wide, and six feet should be allowed for each bed. This would give about 700 cubic feet for each occupant of the dormitory, and this is only sufficient if the ventilation is good. The space allowed is often less than half this amount. In barracks the Government requires 600 cubic feet for each man. In lodging-houses it is sometimes fixed at 350. Children require nearly as much as grown-up people, but the character of ventilation provided is of more consequence than the cubical contents of the room. It is quite possible with good ventilation to do with 300 cubic feet per pupil for young children; without ventilation 700 feet will not be enough. If the height of a room is less than twelve feet, it is better to increase the distance between the beds on each side of the room rather than to make a wider room. It is to be borne in mind that a dormitory which is used as a sick ward, must not be occupied when so used by more than one-half the usual number of occupants, and it may be taken as an established fact that, in sickness, twice as much air is required as when the occupants are healthy. Each boy should have a separate chamber utensil. It is not satisfactory for children to be encouraged to use such things in common, and it is a bad arrangement when there is but one utensil for several children, and one common washing-place provided. Where possible each should, have a separate basin for washing purposes, and all the necessary appurtenances which belong to it in close proximity to it. It is not necessary for these to be by the side of the bed; indeed, for certain reasons it is better that they should not be so situated, but, each child should have access to cold water, and there should always be a plentiful supply at hand, which should be obtained from a pure source without difficulty. The chest which contains the child's clothing should be placed beside the bed, and upon it should be placed some cold water. If the dormitory is wide enough the wash-basins may occupy the centre of the room in a row. All being connected with one discharge pipe which should lose its contents in an open receiver situated on the outside of the house, and from thence be conducted to the sewer. The receiver should have a proper trap, and the pipe connecting it with the sewer would be safer if it discharged on to a grating, and did not communicate directly with the sewer; so that there should be a double impediment to the transit of sewer-air into the bedroom. The best kind of basins are those made of earthenware, which can be lifted up and empty themselves by swinging on an axis when they have been used, such as Jennings and other manufacturers make; they have introduced some excellent kind of basins, which are all managed on a good sanitary basis. The water supply for washing purposes should be plentiful and easy to be obtained. Each pupil should have his own basin and be responsible for its being emptied and washed down after use. Care should be specially observed that the towels, sponges, combs, and brushes belonging to each child should be capable of easy identification, and should be kept for separate use. Each chamber should have a monitor, who should be in charge of the washing-places, and who should see to the proper arrangement and cleanliness of towels, brushes, and combs. There should be a place in each room, especially for girls, for the reception of hair which may have been combed out of the head. This should not be put into the washing-basin, and must be kept out of the drain pipes, as it is a frequent source of stoppage when it is sent into the sewer. The use of grease for the hair should be strictly prohibited. Hair-oil and pomades have certain uses among dirty people, but they are out of place for children who are clean in their persons. In olden times, no doubt, grease on the hair prevented the growth of certain fungi which produced disease in the hair follicles. These fungi cannot grow in greasy matter, but it is far better to trust to washing and brushing, than to grease, for this purpose. If, however, brushes are not kept in order and are not restricted in their use to one person, it will be difficult to prevent infection when disease of hair does unfortunately find its way into a dormitory. Unkempt hair should be a breach of discipline, as much as a flaw in a given lesson. It is really important to observe these rules, for not only may ringworm and scald head be propagated by contact, but ophthalmia of an infectious character often invades schools, even among the higher classes, sometimes producing terrible mischief. In all such cases there has been default on points of cleanliness. It is important, therefore, that towels, brushes, and combs should be kept clean and be restricted to the use of one child only. Each child should have his own, and not be allowed to appropriate that of another boy. Immediately the children have left the bedroom the bedclothes should be thrown open, as well as the windows; and air freely admitted to the bed as well as to the bedroom. It is a serious mistake to have the beds made up as soon as the children have left the chamber. It is still more serious for the children to

be required to make their beds before leaving the room. If they have to make their own beds it should be done after morning study, and after the rooms and the bedding have been thoroughly ventilated. There should at all other times be a tidiness in the bedroom. The clothes which are taken off on going to bed should be placed in some kind of order, not thrown upon or under the bed, but folded up and placed ready for use in the morning. It is a mistake, however, to fold up the night dress immediately it has been taken off, neither should children be accustomed to sleep in their flannel underclothing. Those garments require to be ventilated as well as the night dress; it helps to deprive a child of the great benefit which arises from the use of flannel if it is slept in at night; there ought to be sufficient clothes on the bed for a child not to require it as a covering.

It is very important that there should be a free admission of fresh air during the night, and a continual escape of some of the used-up air. Ventilation must be as efficient in the bed-chamber as in the class-room, and it may be provided in those places which have a gas supply in a manner similar to that recommended for warming and ventilating a schoolroom. However well ventilated a bedroom may be, it should not prevent the opening of the windows immediately the children have dressed themselves, whatever may be the character of the outside air. If there is no gas supply, ventilation is efficiently promoted by a large fire-place in which the chimney has been left open, with Llouvre ventilators of large size above the door of the room. In summer-time the windows should be left open at night so as to admit fresh air from without. This requires an intelligent supervision, and must not be carried out by a hard and fast line. It is very unwise to allow children to sleep in air which is too cold; it is nearly as bad as allowing them to breathe the same air over and over again, or making them act as warming-pans for each other. It is very important that the bedroom should be kept clean, that the floor under the beds should be dusted, a damp cloth should be used for the purpose, and if it be kept damp by water containing a small amount of carbolic acid so much the better. The use of the carbolic water is not so much in destroying any possible infection, but in freshening up the air of the room and producing a rapid tendency to oxidation of any albumenoid matter which may happen to be present.

Besides the troubles caused to superintendents of large schools, by the vicious habits to which allusion has been made, there are others arising from a class of children who are very often harshly treated both at home and at school. I mean those children who are subject to a condition of things which leads them to wet their beds. This is a disease, and not a fault; no amount of punishment can possibly do more than make it worse. It arises from spinal irritation of a particular character, and must be met by special treatment under medical supervision.

In large schools it is best to have a dormitory for the special use of such boys with bedding arranged for the purpose, properly protected, better warmed than an ordinary dormitory, and ventilated a great deal more than is usual in the ordinary sleeping-room. The children should be made to get up about an hour after retiring to rest, and to use the chamber utensil. If they have any difficulty on this point, it may be overcome by putting the hands into cold water. They should be made to lie on their sides and not on the back, and when found lying on their backs they should be turned over on to their side again. Then shortly before 12 o'clock they should be roused and the utensil again used. It will be found that the larger portion of the incontinence of urine takes place before 12 o'clock at night. It will also be found that they are heavy sleepers, and that there is great difficulty in rousing them, and that they are asleep again the moment they lie down in bed. Indeed, after a time they do not recollect that they have been roused at all. It is a cruel thing to punish a child for this misfortune. A room occupied by children so troubled requires to be frequently visited and each sleeper examined. It may be cured by proper arrangements.

I should scarcely leave the subject of sleeping accommodation without a word upon the requirements of nature for sleep. Young children from four to seven require to spend at least half their time in bed. A child of seven should have twelve hours. The length of time to be spent in bed after that age may be gradually diminished, so that at fourteen nine hours is sufficient, at sixteen eight hours. It is important for health that this amount of sleep should be secured to children. The younger pupils should retire to rest first. It is a mistake to make children get up before daylight for the purposes of study. If the nervous system is properly refreshed, more work will be done in a given time than when the work is begun before daybreak and by the aid of artificial light. The standard which is reached in schools where the children work by artificial light in the morning, will not be found so high as in those in which this kind of morning light is more seldom required. It is a custom in some schools to keep the gas alight all night for the purpose of supervision; it as a bad plan. Darkness promotes sleep, and a well managed school in which muscular exercise is properly regulated, should have no difficulty on the score of wakefulness among healthy children.

Anecdotal Natural History.

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No. X.—THE SEAL TRIBE.

LIKE the whales, which formed the subject of the preceding paper of this series, the Seals are inhabitants of the water, although they are not entirely aquatic in their habits, as we shall presently see.

Supposing that we possessed no previous information upon the subject, a single glance at their outward structure would be sufficient to indicate to us the mode of life for which these animals were intended; for the long, slender body, and the broad-webbed limbs, formed almost like the fins of a fish, would at once inform us that the water was their appointed habitation.

For an aquatic life the seals are singularly adapted The form of the body allows them to pass through the water with great facility, and the swimming powers

are so highly developed, that the animals are enabled to pursue and capture the fish in their own element.

If the motions of a captive seal are watched, as the animal disports itself in its tank, it will appear to pass through the water without active exertion, the lithe, supple body going through its manifold evolutions without any visible means of propulsion. By looking a little more closely into the matter, however, we may find out the secret.

The fore-limbs have but little to do with the matter, being used as an aid to progression more upon dry land than in the water. Indeed, when the seal swims, it presses the fore-feet, or flippers, as they are called, against the body. The hinder feet, however, which are not rudimentary as in the whales, but are flat and broad, serve both to propel the body through the water, and also as a rudder to direct its course. And this is managed in a manner very different to what we might expect. The feet do not beat the water, like those of the duck or swan or frog, and thus answer the purpose of oars, but are placed side by side, thus forming a single paddle, set edgewise, like the tail of a fish. These united feet being then swept from side to side, the animal is driven along by the action against the water, a slight alteration only of their position being required in order to direct the course.

By the aid of this simple means of progression, the seal is enabled to traverse the water with wonderful speed, and at the same time with an easy and undulating grace which is equalled by no other creature. This peculiar motion is owing in a great measure to the flexibility of the spine, which allows the body to be bent with facility in almost any direction.

Once upon dry land, however, the graceful movements degenerate into an ungainly shuffle, and the animal reminds the observer of some huge and overgrown caterpillar crawling awkwardly along. The fore-limbs now come into play, and the animal scuttles along, clumsily enough, it is true, but yet with considerable speed.

The nostrils and ears are provided with the means of preventing the ingress of water when the animal dives below the surface, the former closing by their own elasticity, while the latter are furnished with a structure analogous to that found in the whales. There is a curious point concerning the locality of the external ears. The orifice is not placed as we might think, directly over the organ itself, but below, and rather behind the eyes—a passage running beneath the skin to the ear itself.

The whiskers of the seal bear a very strong resemblance to those of the various animals of the cat tribe, their bases being connected with sensitive nerves which warn the animal of the slightest touch. It is thought that these may be of service in the pursuit of prey.

In order to protect the animal from the evil results of continued immersion, the body is clothed in a manner which effectually retains the vital heat. This is done in a threefold manner.

Beneath the skin is found a thick layer of fat, answering the same purpose as the blubber in the whales, and which of itself would, in water of ordinary temperature, be sufficient to retain the animal warmth. Inhabiting, however, as does the seal, the icy waters surrounding the polar regions, something more is necessary. This we find in a double coating of fur, the inner layer—the sealskin of commerce—being of a very fine and silky nature, and the outer of a more coarse and bristly nature, serving as a kind of thatch to the whole. When the animal is in the water this fur is pressed closely against the skin, and, being constantly lubricated with an oily fluid secreted by the skin, is rendered perfectly water-tight, just as is the proverbial 'duck's back.' This coating of fat also serves another and very remarkable purpose.

During the breeding season the adult males come ashore, and each takes possession of a piece of ground, and occupies it together with a number of females. Each male wants to enlarge his territory so as to accommodate more wives, but those who occupy the adjoining spots will fight to the death rather than allow him to encroach on their property.

No male seal, therefore, can leave his ground for a moment, as, if he did so, the surrounding proprietors would at once take possession of it, and carry off his wives. Therefore, he cannot venture into the sea for food; and, if he had not some other mode of sustaining life, would soon die of hunger. But, just as the camel can sustain life by absorbing the fat contained in its hump, so the seal can feed—if we may use the term—on the thick coating of fat which envelops the body.

An adult male seal is really a formidable antagonist. When in best condition, he will weigh some twenty-five stone, and by the mere rush of its onset, and weight of its body, will overset any human foe who does not know how to oppose it.

Strong though the seal may be, it has one part of its body which is as vulnerable as the heel of Achilles. It has been already mentioned that a great number of nerves converge upon the upper lips and nostrils. A blow upon the nose will instantly stun, even if it should not kill, the most powerful seal that ever lived. But it must be well aimed, as the fatal area is very small; and if it be missed, the antagonist will find himself sprawling on the ground, and in very evil condition from the mere weight of the seal as it flounders over him.

My readers may remember the celebrated fight between Hector McIntyre and the 'Phoca,' in Sir W. Scott's 'Antiquary,' and the discomfiture of the too impetuous Highlander.

The food of the seal consists chiefly of fish, which its wonderful powers of swimming enable it to capture with little difficulty. Various molluscs and crustacea, however, also form part of its diet.

In order to assist the animal in seizing its prey, and also in retaining it when once secured, the teeth are formed in a very singular manner. The sharp canines are long and powerful, and the molars are covered with sharp projections of various sizes, so that even the most slippery fish, when once fairly seized, has very little chance of escape. The tongue, for some unexplained reason, is slightly cleft at the tip.

The young of the seal are very few in number, seldom being more than two, and generally only one at a birth. When newly born they are almost white, the colour gradually deepening as they advance in age.

For the first few weeks of their lives the young seals are brought up upon dry land, the mother carefully tending them until they are sufficiently strong to take to an aquatic life.

All the seals are inhabitants of the colder seas, and are especially numerous on the borders of the Polar

Circle. The severity of the climate matters but little to them, for they are rendered secure from cold by their three-fold protection, and can always obtain prey beneath the ice, no matter what may be the season of the year.

In order to prevent the surface of the water from being completely frozen over, and thus separating them from the outside air, a number of seals are accustomed to congregate together into a single spot, thus keeping open a passage by the warmth of their bodies.

These passages are often utilized by the mother for the reception of her young, in the following manner:—

Ascending to the surface of the ice, the seal scrapes away the snow above the entrance to the passage, until she has excavated a small dome-like chamber, much wider than the passage itself. It will be seen that a ledge or shelf of ice must necessarily be left surrounding the aperture. Upon this shelf the baby seal is placed, and is there nurtured in safety by its parent until it is able to shift for itself.

Upon our northern shores, the Common Seal (*Phoca vitulina*) may mostly be seen, and on many parts of the Scottish coast is found in considerable abundance.

Seal-shooting is on these shores a sport which is quite as exciting as deer-stalking, and needs as much of the huntsman's craft. The seal is not only one of the most wary of animals, but it never shows more than its head above the surface of the water, and therefore affords a much smaller mark than a stag. Moreover, even when the sportsman has succeeded in hitting a seal, it often sinks as soon as hit, and he loses it.

Such a misfortune as a seal lost from sinking never occurs to the old hunter, and is a sure proof of inexperience. When a seal comes to the surface after a long dive it remains quiet for a time. A young hunter cannot resist so good a mark, sends a bullet through the animal's brain, and when he reaches the spot finds that it has sunk beyond his reach.

The reason is simple enough.

Like the whale tribes, the seals are enabled to remain for a considerable time under water in consequence of the power of aerating more blood than is required at the time.

Before diving the seal takes a number of long breaths, in order to aerate the blood fully, and just as it dives fills the lungs with a powerful inspiration. As it traverses its course below the water it allows the air to escape gradually, and its course can be easily traced by watching for the bubbles as they ascend to the surface.

Consequently, when the seal rises its lungs are empty, and if it be shot before it has had time to fill them it is sure to sink.

But if the hunter will have patience to wait until the animal has taken in its supply of air, and then shoot it, he will find that the air in the lungs will act like a float, and keep the body at the surface.

THERE are many different species of seals, several of which are named after animals which they are supposed to resemble. One of these is the Leopard Seal (*Leptonyx Weddellii*), or Sea Leopard, as it is indifferently termed, which derives its popular title from the whitish spots which are irregularly sprinkled over the body. This is not one of the larger seals, seldom exceeding ten feet in length, and not often attaining even to those dimensions. It is an inhabitant of various parts of the southern hemisphere.

A MORE interesting and well-known species is the Crested Seal (*Stemmatopus cristatus*), which is found upon the northern shores of America.

Upon looking at a specimen of this animal, the attention is at once struck by the remarkable crest, from which it takes its name. This strange structure springs from the muzzle, and rises to a height of several inches, supporting a kind of cowl which entirely covers the head. This curious organ, which is found in the adult male animal alone, is found to be a development of the 'septum,' or dividing gristle of the nose. As regards its object we are entirely at fault, the theory that it is intended to aid in the sense of smell at once falling to the ground when we consider that it is possessed by the adult males alone, being found only in a rudimentary form in the female and the young of both sexes.

Although the object of this strange development has not as yet been discovered, it is certainly of service to the animal as a means of protection when attacked by man. All the seals being particularly sensitive in the region of the nostrils, it is the usual practice of the hunters to stun them by a heavy blow upon the head, returning to complete the operation when the chase is over. The head of the crested seal is, however, guarded in a great measure by the curious helmet, and a blow sufficient to kill any ordinary seal serves only to stun the animal for a very short time.

When once roused, the crested seal is an active and formidable enemy, using both teeth and claws with considerable activity and address. Its strength, too, is very great, and as the animal averages some eleven or twelve feet in length, it will be seen that it is by no means a despicable foe.

The colour of the fur is a dark bluish black, paling almost to white beneath the body, and sprinkled with a number of greyish patches, each of which encloses a black spot. The head, tail, and feet are black. The fur is of considerable value in commerce, the skins being imported in great numbers.

NEXT comes the Harp Seal, or Atak (*Phoca Grœnlandica*), a closely allied species.

This animal derives its somewhat peculiar name from the markings of the body, which are disposed in a very singular manner. The ground colour of the fur is a whitish grey, upon which are drawn two broad bars of a jetty black running from the shoulders, where they almost join one another, to the root of the tail. The form of these markings has been supposed to resemble an ancient harp, thence its popular title. The greater part of the head is also black.

This peculiar marking does not show itself until the fifth year of the animal's existence, the fur until then changing its colour and markings with every successive season.

The harp seal is an inhabitant of the coast of Greenland and Iceland, where it is found in great profusion, and is much sought after on account of the valuable oil which is obtained from the bodies. Some idea of the extraordinary abundance of these animals may be gleaned from the statement, made a short time since by one of the leading daily newspapers, that one vessel alone, in the course of a single voyage, had procured no less than fifty thousand carcases, valued at more than thirty thousand pounds. In the season

1857, it is also said that half a million of seals were captured by the combined efforts of the vessels engaged in the trade. Success so great, however, is the exception, and not the rule, an ordinary season producing barely half the number of carcases.

Like the common seal, the harp seal is easily domesticated, being often tamed and taught to perform a variety of tricks. Both animals are remarkably docile and intelligent in disposition.

We now come to the huge and ungainly monster known by the various titles of Walrus, Morse, and Sea Horse, and scientifically as *Trichecus Rosmarus.*

This is, perhaps, one of the most extraordinary of all the mammals inhabiting the water, its huge size, its bristle-fringed jaws, and the enormous projecting canine teeth, often nearly two feet in length, causing it to assume a strangely grotesque appearance.

Head of Walrus.

In consequence of the size of these tusks, the jaw is much enlarged in front, the protuberant muzzle giving to the animal a very ferocious aspect. The nostrils, for the same reason, are placed very high in the head. The lower jaw narrows rapidly towards the point, in order to pass between the two canine teeth.

The walrus is found in great quantities upon the borders of the Polar regions, both northern and southern, generally congregating in herds of some six or seven thousand in number. It is an animal of some value, even to civilised mankind, the oil and skin being in considerable request, while the tusks furnish valuable ivory, which has the advantage of retaining its colour for a very long period.

To less civilised nations, too, the walrus is almost a necessity of life; nearly all the soft parts of its body serve as food, while the intestines provide material for the construction of fishing nets, and hooks and other articles being made from the tusks. The sinews serve as fishing lines, and the skin as a covering for the 'kajak,' or boat, so that from the animal are procured the whole of the paraphernalia for obtaining fish. The oil is burnt in the lamps, without which life would be an impossibility, and, in fact, the walrus is to these people what the camel is to the Arab, or the bison to the North-American Indian, a necessary adjunct to existence.

Only a short time before these lines were written, an entire tribe of Esquimaux has perished because the walrus has deserted their coasts.

Skull of Walrus.

So needful do these tribes consider the walrus, that it is almost impossible to persuade them that life in any form is possible without the animals. They even carry the idea to a further pitch, and refuse to believe in the possibility of a future state of existence unless plenty of walrus are to be procurable. In vain the missionaries tried every means in their power to convince them into a belief in the Christian religion. 'No walrus, no heaven,' was the terse and conclusive answer, and there the matter had to rest.

Man is not the only being who recognises the merits of the walrus, for the Polar bear is fully aware of the advantages accruing to the fortunate slayer of the animal. He attacks it in a singular but very effectual manner.

Creeping closely up to the unconscious monster as it lies sleeping upon the shore, he leaps suddenly upon its back, clings to it with his hind feet and one of his fore feet, and delivers a series of tremendous blows upon its head with his unoccupied paw. Usually, this plan succeeds in a very short time, the mighty strokes first stunning the walrus, and at last smashing the skull.

Now and then, however, with an old and exceptionally thick-headed animal, the tables are reversed, the walrus plunging into the sea and carrying its opponent beneath the surface, where, in a few moments, he is obliged to relinquish his hold in order to obtain a supply of air, while his hoped-for prey makes good its escape.

The chase of the walrus, formerly a very easy matter before the animals had profited by bitter experience, is now a business requiring great caution and address.

The great difficulty is to prevent the animals from reaching the water, for which they at once make

when alarmed, passing over the ground at a wonderfully rapid pace. As nothing can stand against the combined onset of the alarmed animals, dogs are employed in order to separate them as much as possible, and to distract their attention from their pursuers. When driven to bay the walrus becomes a very formidable enemy, the huge tusks being capable of inflicting most terrible wounds.

In spite of its enormous size, a full-grown walrus attaining to the length of fourteen or fifteen feet, and weighing as much as a large elephant, the animal has often been tamed, and has even been taught to procure fish for its master, and to bring them to land untouched.

ANOTHER strange and grotesque animal of this tribe is the Sea Elephant, or Elephant Seal (*Morunga proboscidea*), so called from its enormous bulk, and also from the elongation of the snout, which somewhat resembles the trunk of the elephant.

Huge as is the walrus, the elephant seal is far superior in size, having been known to reach the extraordinary dimensions of thirty feet in length, and eighteen feet in the circumference of the body. This strange development, like the helmet of the crested seal, is found only in the adult males. Unless the animal is frightened or alarmed it is not very conspicuous; in such a case, however, the snout is thrown forward, and the animal blows through it with great violence, causing a strange harsh sound, which is audible at a considerable distance.

Notwithstanding their huge dimensions, the elephant seals are by no means so formidable as the walrus, apparently possessing no idea of revenging themselves upon their pursuers. When alarmed, they make for the water, the whole body quivering like so much jelly, on account of the fat with which the body is laden.

From this fat a valuable oil is procured in large quantities, a single animal yielding from seventy to eighty gallons; the skins, also, are of very fine quality.

The elephant seal is an inhabitant of the seas of the southern hemisphere, chiefly between 35 degs. and 55 degs. of south latitude. It is a migratory animal, travelling southwards as summer comes on, and northwards again at the approach of winter.

THE last of the seal tribe which we can mention in this paper is the Sea Lion (*Otaria jubata*), an inhabitant of Kamtschatka and the Kurile Islands, and also of Northern America.

The dimensions of this animal are about equal to those of the walrus, fifteen feet being an average length. Upon the neck and shoulders is a thick mass of stiff bristles, somewhat resembling the mane of a lion; to this is owing the popular name of the animal.

The disposition of the sea lion is very quiet and peaceable, the animal falling an easy prey to the hunters. The animal is remarkable for the hoarse roar which it continually utters when on land, the united clamour of a herd of these creatures being almost deafening to the human ear. Amongst the animals related to its own species, however, it is very fierce and determined, ruling supreme in its own dominions, and holding the smaller animals in complete thraldom.

It seems strange that so mild and apathetic an animal upon shore should be so tyrannous in the water. Yet such is the case, and the sea lion may fairly be considered, even the crested seal not excepted, as the most fierce and savage of all the seal tribe.

(To be continued.)

Sea Elephants.

Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

Joint Author of 'The Field Naturalist's Handbook.'

No. VIII.—THE ORTHOPTERA.

PART II.

THE strange insects bearing the popular title of Mantis are not represented in this country, although in many parts of the world they are plentiful enough. These insects constitute the second group of the *Orthoptera*, and are scientifically known as the *Raptoria*, or Snatchers.

This name they derive from the singular structure of the fore-legs, which are the weapons used in the capture of the prey.

The *coxa*, usually a comparatively insignificant joint, as far as size is concerned, is in these limbs developed to a considerable degree, almost equalling the thigh in dimensions. The thigh is strong, broad, and flat, with a deep groove running along it, this groove being furnished on either side with a number of sharp teeth. The *tibia* is also armed with spikes, and closes into the groove found in the *femur*.

When the mantis is in search of prey, and catches sight of an insect within a convenient distance, it creeps warily up, holding the fore-legs raised above the head, as shown in the illustration. When within striking distance, a rapid stroke is made, the insect is enclosed between the fore-legs, and, the tibiæ being drawn into

Praying Mantis.

the groove provided for them, the prey has no chance of escape.

This peculiar attitude of the fore-limbs was formerly thought to be that of prayer, and the insect was termed the Praying Mantis accordingly.

These insects are still regarded with superstitious feelings in many parts of the world. In some countries, for instance, it is thought that any one losing his way in the forest, and inquiring of the first mantis he sees, will be instantly directed by the insect, which is supposed to point out with the fore-limbs the necessary direction.

Most of these insects resemble in colour the foliage of the trees which they frequent, some species even changing their hues in accordance with the tints of the leaves at different periods of the year. It may thus be imagined, when the protective colours and the peculiar form are taken into account, that the insects are by no means easily to be detected.

Passing by the next group, namely, the *Ambulatoria*, which comprises the various Leaf and Walking-stick insects, none of which inhabit Great Britain, we come to the fourth and last division of the *Orthoptera*, viz., the *Saltatoria*.

As their name implies, the insects of this group, which includes the grasshoppers, locusts, etc., possess the faculty of leaping from the ground, sometimes to a considerable height.

As is the case with all leaping insects, the power lies in the hinder limbs, the thighs of which are long, and of very great comparative size.

The first family of this division comprises the *Achetidæ*, or Crickets, with the commoner species of which almost every one is more or less acquainted. These insects may be recognised by the size of the antennæ, which are generally almost equal in length to the body, and by the structure of the wings, which, when folded, are not entirely concealed by the elytra, but project for some distance beyond them. The males are furnished with two long antenna-like bristles at the end of the body, which appear to warn the insect of any danger approaching from behind; in the female the place of these organs is taken by the ovipositor, which is usually of considerable length.

The shrill noise uttered by the male insect is produced by the vibration of the elytra against one another, a rather curious modification of those organs giving rise to the sound. In each wing-case, a stout nervure starts from a thickened spot, some little distance from the base; in the right elytron the under side of this nervure is regularly notched, as though it had been grooved with a file.

When the insect is at rest, and the wings closed, the right elytron lies above the left in such a manner that the notched nervure rests upon the corresponding one in the left wing-case. The elytra are then put into rapid motion, and the grooved nervure rasps upon its fellow, with the result of causing the shrill sound with which we are so familiar.

The elytra differ to a considerable extent in the two sexes, and in some species form almost the only means of distinguishing between them.

The most abundant of our native species is, of course, the common House Cricket (*Acheta domestica*), which needs little or no description.

One peculiarity, however, lies in the structure of the ovipositor. This organ is very long and slender, and is terminated by a broad and sharpened tip, looking somewhat like the head of a spear. This apparatus is double, each of the parts being hollow, with a deep groove running along the entire length, thus forming a tube through which the egg can pass.

The spoon-shaped termination is also double, or rather quadruple, each of the parts being cleft along the centre, and opening and closing at the will of the insect. By this means the egg can be placed in a narrow aperture, being held, meanwhile, by elastic springs, which can be relaxed or contracted as necessity requires.

Another of our British species is the Field Cricket (*Acheta campestris*), which, although plentiful enough in many parts of the country, is, owing to its cautious and retired habits, far more often heard than seen.

This insect is not gregarious, each specimen living in a separate burrow, which it seldom leaves, except at night.

Being very wary creatures, retreating into their

tunnels at the mere sound of a footstep, they are not easily obtained. Strategy, however, will often succeed where open attack fails. For this cricket is easily roused to anger, and if a grass stem, or other similar object, be poked down the burrow, is sure to seize the intruder with its powerful jaws; a sharp jerk will then usually draw the insect from its retreat before it is able to relinquish its hold.

Like the domestic cricket, this insect is of a very quarrelsome nature, and if a number of specimens are placed together, a battle is sure to ensue, the combatants attacking one another with such fury that limbs are often torn from their bodies, and the weaker insects usually pay the penalty of their rashness with their lives.

Amongst the foreign crickets must be mentioned the extraordinary species known as *Acheta monstrosa*, which is remarkable for the structure of the claws, and also for the great length of the antennæ, each of which is composed of the wonderful number of two hundred and forty joints. The burrows sunk by this insect sometimes attain three feet in depth.

Closely allied to the preceding insects, although placed in a different genus, is the curious Mole Cricket, Croaker, or Chur Worm, as it is often called (*Gryllotalpa vulgaris*).

Mole Cricket.

This insect well deserves its popular title, bearing a strange resemblance, both in form and habits, to the animal from which it derives its name.

The fore-legs are constructed expressly for the purpose of burrowing through the earth, the *tibiæ* being broad, flat, and powerful, and armed with long and sharp claws, and the form of the limb almost exactly corresponding with that of the digging leg of the mole.

Digging Leg of Mole Cricket.

The *tarsus*, or foot, is small, and of little use during the operation of tunnelling, being packed out of harm's way beneath the broad *tibia*. This curious apparatus is well represented in the accompanying illustration.

In this insect the female is not provided with an ovipositor; the only method of distinguishing the sexes by outward examination lying in the structure of the elytra, as mentioned above, the notched nervure being present in the male alone. It is a curious fact that in the male the right elytron overlaps the left, while in the female the reverse is the case.

The colour of the insect is a rich reddish-brown, becoming considerably darker upon the thorax, and paling almost to yellow beneath the body. The elytra are also paler, with dark nervures.

The mole cricket is generally to be found in sandy soils, where it tunnels to considerable distances beneath the surface. A separate chamber is always constructed for the reception of the ova, and is situated near the surface of the ground, in order that the heat of the sun may penetrate to the cavity, while the eggs are protected from foes. The entrance to this cell is always at some little distance, a tunnel connecting it with the outer world.

Although this insect resembles the mole in so many points, it differs from that animal in one important particular, viz., the benefits it confers upon mankind. The mole, as has already been explained in these pages, is of the greatest service to agriculturists, its numberless tunnels answering the purpose of a most complete system of subsoil drainage, the earth brought to the surface serving to renew the soil, while the food of the animal consists chiefly of the grubs of those insects which find their food in the roots of the various crops, and whose destruction is therefore a matter of the greatest importance.

The mole cricket, however, affords us none of these benefits. Its tunnels are too few and slight to be of any value as far as drainage is concerned, and instead of preying upon the insects which damage the crops, it joins forces with them, feeding chiefly upon the roots of various vegetables. When the insects are plentiful, they have sometimes been known to cause considerable damage to garden plants of different kinds.

Their diet, however, is not always of a vegetable nature, for they have often been known to feed upon raw meat. Occasionally, also, they evince cannibalistic propensities, and attack their weaker brethren, the conqueror invariably devouring his vanquished foe.

We now come to another family, namely, that of the *Gryllidæ*, or Grasshoppers, our first example of which is the Great Green Grasshopper (*Acrida viridissima*), which is a tolerably abundant insect in most parts of the country.

The colour of this species is the most vivid green, which, however—as is almost invariably the case with insects of that hue—fades almost immediately after death, and becomes a dingy yellow-brown. Owing to the similarity of colour between the insect and the leaves of the trees which it inhabits, it is comparatively seldom seen, in spite of its abundance, even a practised eye often passing it by without detection.

The sound emitted by this insect is very loud and shrill, and can be heard at a considerable distance. It is a curious fact that, to some, this sound, powerful as it is, is perfectly inaudible, the note being too shrill for the auditory nerves to transmit to the brain. A friend of my own is included among this category of individuals, although, strangely enough, he can detect the cry of the bat, which is of an even higher pitch, with the greatest ease.

The young of this grasshopper bear a strong resemblance to gigantic aphides, furnished with leaping limbs. They differ from the perfect insect in the absence of wings, and, in the females, of the ovipositor, which does not make its appearance for seven or eight weeks from the time of the commencement of the larval existence.

In the perfect insect this organ is formed in a somewhat singular manner, consisting of a number of blades, which can be separated in order to allow the egg to pass between them.

Another species is the Tree Grasshopper (*Meconema varia*), which is generally to be found upon the oak. This species has the peculiarity of being perfectly silent.

We now come to the well-known Locusts, which, happily for us, are extremely rare in this country. However, a few specimens almost annually find their way to our shores, and many more are chronicled, almost any large insect doing duty as one of these creatures. Even such totally dissimilar insects as the Death's-head and Humming-bird Hawk-moths have more than once been mistaken for the genuine locust. Most of the true locusts which are found in this country belong to the same species, *i.e.*, the Migratory Locust (*Pachytylus migratorius*), a representation of which accompanies this article. The colour of the insect is a pale brown, the elytra being marked with darker spots; the wings, which are broad and powerful, have a slight greenish tinge.

Great Green Grasshopper.

The destructive nature of the locust is only too well known, and there is little need to enlarge upon it in these pages. I may, however, be permitted to quote a passage from Lady Brassey's well-known work, 'A Voyage in the *Sunbeam*,' with reference to their numbers.

'In the course of our ride, we saw in the distant sky what looked very much like a heavy, purple thunder-cloud, but which the experienced pronounced to be a swarm of locusts. It seemed impossible; but, as we proceeded, they met us, first singly, and then in gradually increasing numbers, until each step became positively painful, owing to the smart blows we received from them on our heads, faces, and hands. As the locusts passed between us and the sun, they completely obscured the light; a little later, with the sun's rays shining directly on their wings, they looked like a golden cloud, such as one sometimes sees in the transformation scene of a pantomime; and, at a greater distance, when viewed from the top of a slight eminence, they looked like a snow storm, or a field of snow-white marguerites which had suddenly taken to themselves wings. When on the ground with their wings closed, they formed a close mass of little brown specks, completely hiding the ground and crops, both grass and grain. In riding over them, though not a quarter of their number could rise, for want of space in which to spread their wings, they formed such a dense cloud that we could see nothing else, and the horses strongly objected to face them.'

The same author also states that railway trains are sometimes stopped by these creatures, not so much from their numbers, as that, on account of the oil flowing from their crushed bodies upon the line, the wheels will not hold the rails.

Only a year or two ago, also, during the Russo-Turkish war, the advance of a large army was stopped by a vast flight of locusts, which rendered progression utterly impossible until, after the lapse of a considerable time, their numbers had somewhat diminished.

Some idea of their multitudes may be formed from the fact, related by a modern traveller, that, after a severe storm, the locusts were heaped up into a vast bank three or four feet in height, and fifty miles in length.

Migratory Locust.

It seems strange that insects furnished with such broad and powerful wings as are the locusts, should yet possess so little power of directing their flight. Yet such is the case, and the insects are unable to withstand the force of even a gentle breeze, being carried about by the wind and forced to travel in the direction in which it is blowing, always seeming to keep their heads to the wind and to drift backwards. For this reason great numbers perish by being blown out to sea, their dead bodies, when washed up by the tide, often forming a high wall many miles in length. They are also peculiarly susceptible to the effects of cold, and perish in multitudes

should there be any great falling off in the temperature.

Although to civilised man the locust must be regarded as an unmitigated pest, it is not so to him when in a state of nature. Many savage tribes, indeed, consider a flight of these insects in the light of a blessing rather than a curse. They have no crops, and therefore nothing to lose by the ravages of the insects. On the contrary, they gain by their advent, collecting the insects in vast quantities, and using them as food.

The mode of capture is simple in the extreme. Large fires are lighted, and fed with damp wood; this, of course, causes a thick smoke to ascend. The locusts, powerful insects as they are, have but little power of directing or altering their flight, and fall to the ground in myriads, stupefied by the smoke, when they are collected without difficulty.

By these people, the bodies of the locusts, when cooked, are considered as positive dainties, and the approach of a swarm is hailed with the greatest delight. Travellers, however, differ greatly in their accounts respecting this strange diet, some saying that it is almost nauseous, while others hold a diametrically opposite opinion. In one book we read that the flavour of the insects can only be compared to a mixture of linseed cake and burnt feathers, while another tells us that locusts form an admirable substitute for shrimps, from which creatures the sense of taste is unable to distinuish them. *De gustibus non est disputandum.*

Many other species of locusts are found in different parts of the world, none of them, however, causing such terrible havoc as that which has been above described, and which may fairly rank as the most destructive insect upon the face of the earth.

(To be continued.)

'How I Teach Elementary Science.'

FOURTH SCHEDULE SUBJECTS: MECHANICS.

BY RICHARD BALCHIN.

IN last month's issue the reader will find a syllabus of one year's course of lessons in the second stage 'Mechanics.' I will now reproduce, as far as I am able to remember, a few lessons actually given before a division of V. and VI. Standard boys. I must here, however, remark, that at times the lesson may not appear to follow on in logical sequence, the break being caused by a thoughtful remark from one of the boys. It is never my plan to dismiss such a remark, but rather to work upon it. A boy is often discouraged to think, by the teacher's want of consideration for some question that the boy has put—a question which is often the outcome of a good deal of thought on part of the boy. I sometimes see, in the eyes and countenance of a child, that ideas are revolving in his mind, leading him to conclude that what I am saying does not exactly fit in with what he thinks; so he puts a question, which I may perhaps find a little inconvenient. Still it is, I think, better to step aside—of course within certain limits—and put the boy right. But so doing, I not only fix *his* attention for the remainder of the lesson, but probably awaken interest in other little minds that have been similarly exercised. What I feel I must do is this—to get, as it were, into the child's mind myself; to note all the avenues by which ideas enter; to see how they enter, and how they fix themselves there; how they associate with other ideas already there, and so by general union generate mental force; just as the union of atoms in the material world generates heat force.

The following lesson is the first on 'Matter in motion':—

Do you remember, boys, our lesson upon matter? Ans.—Yes, sir. Well, tell me something that we decided was not matter? Ans.—Sound. Now, something that *is* matter? Ans.—Wood. What term did we use for any very small division of matter? Ans.—Particle. Are there any particles in this room? Ans.—Yes, sir. Where? Ans.—On the ground; on our clothes; in the air. Can you see any particles in the air? Ans.—Yes, sir; in that sunshine. Are they in any other part of the air besides in that sunshine? Ans.—Yes, sir. How do you know that? you can't see them. Ans.—But when the sun shines in the other windows we can see them just the same. Very good. Now look again at the particles in those rays of light; what do you notice about them? Ans.—They are all moving about; all going from one place to another. Yes, and that boy has given such a good definition of motion that I will write it on the board:—'Motion is change of place.' Are the particles of dust on my coat, or the particles of chalk on that black-board, moving about? Ans.—No, sir. Yes, sir. Smith, you said 'no'; why did you say so? Ans.—Because they are not changing their place; they are quite still. Bayley, you said 'yes'; why did you say so? Ans.—Because *you* are moving about, sir; so the particles must be moving about too. Well, then, are there any particles in this room that are quite at rest—that do not move at all? Ans.—Yes, sir; on the ground; on the table; on the black-board. Bayley, do *you* think the particles on the ground are at rest or in motion? Ans.—(from Bayley) At rest. (Here several boys are getting excited, and half rising to ask questions.) But it was you, Bayley, who said the particles on my coat were moving because *I* was moving. Ans.—Yes, sir, I did; but the ground is not moving. (Here a boy jumped up, seemed all ablaze, and about to explode.) Please, sir, the ground *is* moving; all the world is moving. Well, Bayley, what do you say to that? Ans.—I know that the world is moving round the sun, but I was not thinking about *that* motion; I was thinking of the other. The other? What other? Are there, then, two kinds of motion? No answer? Now, boys, look at that sunshine again. You see the particles of matter, do you not? Ans.—Yes, sir. And you told me they were in motion; how do you know that? Ans.—Because we can see them in motion. Have those particles any motion that you or I cannot see? Ans.—Yes, sir. What motion is that? Ans.—Along with the air round the sun. Why can't we see that motion? Ans.—Because we are all going too. Just so. Suppose you wanted to tell a person of those two kinds of motion, how would you describe them? Ans.—I should say that one motion we can see, and the other we can't. (Another boy)—One motion is all about among themselves, and the other motion is altogether the same way. Very good; that boy is thinking. Now I will write on the board, words to describe those two kinds of motion. The first we will call 'Relative motion,' and the second 'Absolute motion.' When I was in the train on Saturday, I placed three books on the seat by my side, and they remained there until I took them up.

Were they at rest? Ans.—No, sir; not really, because they were moving with the train. Which of the two kinds of motion had they? Ans.—Absolute motion. (A boy)—Please, sir, they had relative motion as well. Indeed? Why do you think so? Ans.—They were moving with respect to the trees in the field. Yes, so they were. I am very pleased, Johnson, to find you are thinking. Now, is there any sense in which we could say the books were at rest? Ans.—Yes, sir; they were at rest among themselves. Well, now could you use one of those words on the board for that kind of rest? Ans.—Yes, sir. Which one? Ans.—Relative. Just so. We could say that they were at rest relatively but in motion absolutely. Can you tell me of anything that you consider at rest absolutely? Now think. Ans.—The air in this room. (Another boy)—The air is in motion, sir; our breathing puts it in motion. (Another boy)—Of course the air is in motion, for that makes the particles in the air move about. (Another boy)—Besides that, the air is moving with the earth round the sun. (Another boy)—There is not anything that is absolutely at rest. (Another boy)—Yes there is, sir; the fixed stars are. (Another boy)—Please, sir, it says in our reading book that all the fixed stars are really moving round some other star. (A boy)—Well, then, that other star that they all go round is at rest. Now, boys, the fact is, there is not a single object or atom of matter in the whole universe that, as far as we know, is absolutely at rest. This fact I will write down on the board. 'Motion is the law of the universe.' Take out your exercise books and write:—'Motion is change of place, rest is its opposite.' 'Relative motion happens when one thing changes its place with respect to some other thing.' 'Absolute motion happens when all are in similar motion together.' 'Relative rest happens when one object is at rest with respect to another.' There is no absolute rest. 'Motion is the law of the universe.'

Practical Organic Chemistry for 2nd B.Sc. Exam., London Univ.

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[This article is supplementary to the Author's 'Text Book of Practical Organic Chemistry,' to which the references apply, and treats of those subjects required for the 2nd B.Sc. Exam. that are not contained therein. It is believed that the information necessary to secure a pass in that examination can be obtained, in a collected form, only from these sources].

ACIDS.

HYDROCYANIC ACID, HCN (HCy.)

The reactions of the simple cyanides are given at page 79. But it is necessary to observe that often two simple cyanides will combine and produce a compound which has properties quite distinct from those of either of its constituents. Such compounds are called *double cyanides.*

The need of special methods for the analysis of certain double cyanides will be rendered obvious by the consideration of an example. Ferrocyanide of potassium (K_4FeCy_6) is a double cyanide, which we may consider as produced by the combination of four molecules of KCy with one molecule of $FeCy_2$; but these molecules are so intimately connected together that the ordinary methods of analysis fail to demonstrate the presence of either KCy or iron in the compound.

Some double cyanides have therefore to be considered as salts of a single metal, the other metal being viewed as a constituent of a complex acid. Thus, analytically considered, ferrocyanide of potassium is the potassium salt of hydroferrocyanic acid (H_4FeCy_6), and not a compound of potassic and ferrous cyanides.

Some double cyanides are easily decomposed by dilute acids with evolution of HCy. Such need no special methods for their examination, although without a little care they may prove somewhat perplexing. For instance, the double cyanide of potassium and zinc ($2KCy,ZnCy_2$) is readily soluble in water. On adding dilute hydrochloric acid, the following reaction takes place:—

$$2KCy,ZnCy_2 + 2HCl = ZnCy_2 + 2KCl + 2HCy,$$

the $ZnCy_2$ being precipitated. Cyanides precipitated in this way may be readily dissolved by warming with more acid, or if needs be, pouring off the solution and warming with stronger HCl. There is then no further difficulty.

Hydrocyanic acid existing as simple cyanides may be detected in the presence of difficultly decomposable double cyanides, or sulphocyanates, by the reaction No. 3 at page 80.

The ferrocyanides and ferricyanides are the only difficultly decomposable double cyanides of common occurrence, and a study of the properties of these will enable one to deal with others if necessary.

HYDROFERROCYANIC ACID (H_4FeCy_6).

All ferrocyanides are decomposed on ignition; for example:—

$$K_4FeCy_6 = 4KCy + Fe + C_2 + N_2;$$

and on ignition with alkalies or alkaline earths, they give off their nitrogen as NH_3.

Ferrocyanides of the heavy metals are insoluble in water, and mostly insoluble in dilute acids; the alkaline salts are readily soluble in water to neutral solutions.

1. To K_4FeCy_6 add dilute HCl or H_2SO_4, and notice that no action takes place. On boiling HCy is evolved (see page 18).

2. To a small quantity of powdered K_4FeCy_6 in a test-tube, add strong H_2SO_4 and warm gently. Carbonic oxide is evolved, which may be ignited at the mouth of the tube (see page 21).

3. To a dilute solution of K_4FeCy_6 add Fe_2Cl_6. A precipitate of ferric ferrocyanide, or Prussian blue, is obtained.

$$2Fe_2Cl_6 + 3K_4FeCy_6 = Fe_4(FeCy_6)_3 + 12KCl$$

This precipitate is unaffected by dilute acids, decomposed by alkalies as explained below, and soluble to a dark blue solution if the K_4FeCy_6 is kept in sufficient excess.

4. To a dilute solution of K_4FeCy_6 add $CuSO_4$. A chocolate brown precipitate of Cu_2FeCy_6 is produced, which is insoluble in dilute acids, and decomposed by alkalies.

5. To solution of K_4FeCy_6 add $FeSO_4$. A light-blue precipitate is obtained, which rapidly darkens on exposure to air. This precipitate is white if the ferrous salt is quite free from ferric, and oxidation is prevented. Its composition is, when pure $K_2Fe(FeCy_6)$.

6. To a solution of K_4FeCy_6 add $AgNO_3$. A white precipitate is obtained, Ag_4FeCy_6, which is insoluble in dilute HNO_3 or AmOH.

Oxidizing agents such as chlorine, convert all soluble and some insoluble ferrocyanides into ferricyanides, the iron being changed from the ferrous to the ferric condition thus:—

$$2K_4FeCy_6 + Cl_2 = K_6Fe_2Cy_{12} + 2KCl.$$

HYDROFERRICYANIC ACID, $H_6Fe_2Cy_{12}$.

Ferricyanides are decomposed on ignition in a similar way to ferrocyanides. The alkaline ferricyanides are soluble in water, the others mostly insoluble. The following reactions are numbered to correspond with those of hydroferrocyanic acid.

1. Ferricyanides are not acted on by cold dilute acids.

2. When warmed with strong H_2SO_4, carbonic oxide is evolved.

3. To a dilute solution of $K_6Fe_2Cy_{12}$ add Fe_2Cl_6. No precipitate is produced, but the solution is turned brown. Add a drop of sulphurous acid or solution of $NaHSO_3$, a dark blue precipitate falls at once. It should be noticed that the reduction of either compound, causes a dark blue precipitate.

4. Cupric sulphate gives with $K_6Fe_2Cy_{12}$ a dirty greenish yellow precipitate.

5. To a solution of $K_6Fe_2Cy_{12}$ add $FeSO_4$. A dark blue precipitate of ferrous ferrocyanide or Turnbull's blue ($Fe_3Fe_2Cy_{12}$) is obtained.

6. To a solution of $K_6Fe_2Cy_{12}$ add $AgNO_3$. An orange-coloured precipitate of $Ag_6Fe_2Cy_{12}$ falls. It is insoluble in dilute HNO_3, soluble in AmOH.

The solubility of this precipitate in AmOH sometimes occasions a difficulty in looking for HCl. In such a case, it is best to slightly acidulate a part of the solution with HNO_3, then to add $ZnSO_4$ which will precipitate the $H_6Fe_2Cy_{12}$ (also H_4FeCy_6 and HCy), filter, and test the filtrate for HCl as usual. This method of separating the cyanogen acids will often be found convenient.

Potassic ferricyanide is very readily reduced in alkaline solutions to ferrocyanide, by almost anything that is capable of oxidation—including filter paper.

INSOLUBLE DOUBLE CYANIDES.

The presence of such a substance may generally be ascertained by collating the results of the examination in the dry way, the preliminary examination for acids, and the solubility of the mixture. If still doubtful, warm the substance with water, wash the insoluble residue well, add NaOH and heat to boiling, filter, and test the filtrate by acidifying it with HCl and adding Fe_2Cl_6, and if no blue colour is produced, a drop or two of SO_2 solution. If no blue colour is obtained, there are no insoluble ferro- or ferricyanides present.

If an insoluble double cyanide is present, the analysis of the substance should be carried out as follows:—

1. Examination in the dry way.
2. Preliminary examination for acids.
3. Make an aqueous extract of a suitable quantity of the substance, and examine this extract in the wet way for bases and acids as usual.
4. Wash well the residue that is insoluble in water, add NaOH to it, heat to boiling and filter. Examine a part of this extract for the bases of the Cu,As and Ni,Al groups (some of which metals are soluble in NaOH), and the other part for acids, *except HCl and H_2SO_4* (chlorides and sulphates are invariably contained in caustic soda). To test for H_4FeCy_6 and $H_6Fe_2Cy_{12}$, acidify with HCl and add Fe_2Cl_6, and if necessary SO_2 (see reactions for these acids numbered 3 and 5).
5. The residue not soluble in soda must be washed very carefully, and dissolved in HCl, and examined as usual for bases, except alkalies, and for phosphoric acid, which it will be seen may be present as alkaline earthy (or Al or Cr) phosphate.

URIC ACID, $C_5H_4N_4O_3$.

Uric acid is practically insoluble in water (also alcohol and ether), but soluble in alkaline liquids. This should be confirmed by adding some water to the acid and warming, then alkali to dissolve it. Acids precipitate uric acid from its solutions.

Urate of ammonia is sparingly soluble in cold water, so that a solution of uric acid in hot ammonia deposits crystals on cooling.

Heat a small quantity of uric acid in a bulb tube. Notice that the acid does not melt nor swell up, and that the black residue is less in bulk than the acid taken. Also observe the crystalline sublimate, and that hydrocyanic acid is evolved during the heating.

1. Warm some uric acid with dilute HCl; no change is perceptible.

2. Warm some cautiously with strong H_2SO_4, and notice that it gradually dissolves. At a certain temperature, a vigorous evolution of SO_2 takes place, and the liquid becomes of a dark red colour. On adding water it will be evident that complete solution has taken place, and that there has been no blackening. This reaction should be tried three or four times, and it will be found difficult to secure uniform results.

3. Moisten some dry uric acid with strong HNO_3 in a porcelain dish, and carefully dry it. A red residue is obtained, which is turned to a reddish purple by ammonia, or a blueish purple by potash. These colours are very intense, and the reaction altogether very characteristic.

GALLIC ACID, $C_6H_2(OH)_3.CO.OH$.

Gallic acid dissolves readily in hot water or alcohol.

Heat a small quantity of the crystals in a bulb tube; it melts, gives off water, then blackens and evolves a red substance, which will be found as an ill-defined sublimate.

Heat a portion on platinum foil, and observe that it melts and gives off white fumes, then turns red, then black and burns with a luminous flame, and leaves a black residue, which may be burned by further heating.

1. Heat a small quantity of gallic acid with dilute HCl; it dissolves, the acid having apparently no effect on it.

2. Heat a further quantity with strong H_2SO_4, and notice that the gallic acid dissolves, and that the liquid

gradually assumes a rich red colour from the formation of rufigallic acid. If a few drops of the solution are poured into water, the rufigallic acid separates on standing for a minute or two as a reddish-brown precipitate. On heating the strong H_2SO_4 solution to a higher temperature it readily blackens.

3. To an aqueous solution of gallic acid add Fe_2Cl_6. A blue-black precipitate or colouration is obtained. To part of the liquid add HCl; the colour disappears. Heat another part until it is decolourized. The gallic acid is oxidized by the iron salt, which is itself reduced. It follows, therefore, that cooling will not restore the colour, but that if the gallic acid is in excess, the addition of an oxidizing agent (sodic hypochlorite), or more Fe_2Cl_6, will give a further black colour.

4. Gallic acid gives no precipitate with gelatin, albumin, or starch paste.

5. To an aqueous solution of gallic acid in a porcelain dish, add NaOH. The liquid rapidly turns reddish-brown, and deposits a black substance. AmOH produces the same effect, but more slowly. These changes do not take place if oxygen is excluded.

TANNIC ACID, $C_{14}H_{10}O_9$.

The above formula for tannic acid is that of two molecules of gallic acid minus one of water. Natural tannin is probably a glucoside of this body, so that the commercial article contains glucose, in quantities varying according to the extent of its purification. These differences, however, will be found to influence the following reactions, but slightly. The numbers are the same as those prefixed to the similar reactions of gallic acid.

Tannic acid is readily soluble in water, but not so soluble in solutions of salts, acids, etc. Hence the addition of acids to aqueous solutions of tannic acid may precipitate it, but it readily redissolves on adding more water or warming.

Heat a small quantity in a bulb tube, and notice that it behaves much like gallic acid, but swells up rather more, and probably gives off the odour of burning sugar.

Heated on platinum it fuses, blackens at once, and burns more readily than gallic acid, the difference being chiefly, if not altogether due to the presence of glucose.

1. Heat a small quantity of tannic acid with dilute HCl; no apparent change takes place.

2. Heat a portion of the solid with strong H_2SO_4; the solution becomes reddish, but speedily blackens. The smaller the quantity of glucose, the less rapid will this blackening be.

3. To an aqueous solution of tannic acid add Fe_2Cl_6. A black precipitate is obtained of a blueish or greenish tint. The colour disappears at once on the addition of HCl, and slowly fades on boiling, like the corresponding colour given by gallic acid.

If $FeSO_4$ is used instead of Fe_2Cl_6, the colour produced at first will be very faint, and darken gradually as the iron-salt gets oxidized. With this reagent gallic acid shows a little difference of colour, but it is not safe to rely on this difference as a method of distinguishing between tannic and gallic acids.

4. To a rather strong solution of tannic acid add a solution of gelatin * and shake. A yellowish-white precipitate forms at once. More dilute solutions should be treated in the same way, as the precipitate is not so easy to recognize when in small quantity. Starch paste and albumin give white precipitates with tannic acid.

5. Alkaline solutions of tannic acid resemble those of gallic acid in absorbing oxygen, and so gradually assuming a dark reddish-brown colour.

* Conveniently prepared by boiling a small piece of parchment (or fine shavings of glue or isinglass) with water for a few minutes.

NEUTRAL BODIES.

ALCOHOL, $\begin{array}{l} CH_3 \\ | \\ CH_2OH. \end{array}$

This is the only liquid substance mentioned in the Syllabus for the 2nd B.Sc. It may readily be distinguished from water, or detected in an aqueous solution, by its smell and inflammability.

If mixed with water, the liquid must be subjected to fractional distillation, care being taken to distil over only a few drops of the liquid at first, this portion being tested as to its inflammability and smell. A further quantity may then be distilled, and warmed with a rather dilute solution of potassic dichromate, acidulated with H_2SO_4. If the chromate is reduced, that is, changed from red to green, the presence of alcohol may be considered as proved. If the chromate solution is too strong, the change of colour will be incomplete, unless indeed the alcohol is present in a correspondingly large quantity.

STARCH, $(C_6H_{10}O_5)_n$.

Starch is an organized body, and its different varieties may be distinguished by means of the microscope. But chemically considered, all the starches have the same properties.

Shake up a small quantity of starch with some water. The starch does not dissolve, and if set aside, it will settle down, and may be completely recovered.

Take another part, and instead of allowing the starch to settle, warm it gradually until it gelatinizes and forms a mucilaginous liquid. This is called 'starch-paste'; the heat has burst the starch granules, and the substance of them is diffused through the water. It is not generally allowed that this is a true solution, although it may be diluted and filtered without separating the starch.

On ignition in a bulb-tube, starch blackens, and yields much water with acid fumes. Heated with free access of air, as on platinum foil, it appears to melt, then burns with a bright flame, and leaves a black residue, which may be burned away by further heating. An ash remains, but this is almost imperceptible when small quantities are used.

1. Heat some starch with dilute HCl to boiling, and observe that it gelatinizes much less than when heated with water. By the prolonged action of dilute acids it is entirely converted into soluble substances.

2. Warm starch with strong H_2SO_4. The liquid soon blackens, grows thick, and evolves a slight odour of burning sugar.

3. Prepare some starch-paste as described above, and allow it to cool. Add to it a solution of iodine (either in potassic iodide or in alcohol); a deep blue precipitate or solution is produced. Divide the liquid into several parts, and see that the colour disappears by the application of heat and returns on cooling, un-

less the iodine has been volatilized. The colour is not affected by dilute acids, but is destroyed by reagents that cause the iodine to enter into combination, as alkalies, sulphuretted hydrogen, etc.

GRAPE SUGAR (GLUCOSE), $C_6H_{12}O_6$.

Water dissolves nearly its own weight of grape sugar, to form a viscous liquid. Dilute solutions are comparatively limpid.

Heat a small quantity of grape sugar in a bulb tube. It melts readily, froths up, turns black, and evolves water and the odour of burning sugar. Heated on platinum foil it behaves in a similar way; the black residue may be burned by continued heating, and a white ash obtained if the sugar was no purer than is common.

1. Warmed with dilute acids, glucose undergoes no visible change.

2. Put a small quantity into strong H_2SO_4. So long as the acid is cold, it will fail to blacken even if allowed to act for hours; but on warming it speedily blackens, and grows thick with effervescence.

3. To a solution of grape sugar add NaOH and boil. The liquid turns to a reddish brown colour, and a humus-like substance is formed, which will deposit on standing.

4. To a solution of grape sugar add a few drops of $CuSO_4$, then excess of NaOH. In the presence of the sugar the copper is not precipitated, but forms a blue solution. Gently warm the mixture, and notice the precipitate, at first brownish yellow cuprous hydrate, afterwards bright red cuprous oxide.

UREA, $CO(NH_2)_2$.

This substance is best considered as a neutral body, for it gives no reactions with the general reagents for organic bases (see next section), although it combines with many acids to form salts of greater or less stability.

Urea dissolves with ease in either water or alcohol, but is nearly insoluble in ether. Cold water dissolves its own weight of urea.

Heat a small quantity of urea in a bulb tube, and notice carefully the very characteristic decomposition that ensues. It melts to a water-like liquid at 120°, then appears to boil, and gives off large quantities of ammonia, and forms a small sublimate. On continuing the application of heat, the residue grows less liquid, the sublimate greatly increases, and the odour of ammonia is exchanged for a short time for the sharp acid odour of cyanic acid, which is characterized by its effect on the eyes. There is no blackening, and the final residue is inappreciable.

1. On warming urea with dilute HCl there is no apparent change.

2. Heat a small quantity with strong H_2SO_4. It gradually dissolves, and at a temperature at which the acid begins to fume, a vigorous effervescence sets in, due to the escape of CO_2. The nitrogen remains as an ammonia salt, thus:—

$$CO(NH_2)_2 + H_2SO_4 + OH_2 = CO_2 + (NH_4)_2SO_4.$$

There is no blackening.

This conversion of urea into $CO_2 + 2NH_3$ by the assimilation of water, may also be brought about by boiling it with alkalies in aqueous solution. In this case the CO_2 remains with the alkali, and the ammonia is evolved; but this action is slow, even if the alkali is fairly concentrated; the detection of the ammonia, therefore, is not a very good reaction for the presence of urea.

3. To a rather strong aqueous solution of urea add about one fifth its bulk of strong HNO_3. A precipitate of crystalline laminæ or rhombic plates of nitrate of urea will speedily form. In a dilute solution, these crystals may take some hours to deposit, but they will be of more characteristic appearance. A concentrated solution of oxalic acid gives a similar reaction with urea.

4. To a solution of urea add an excess of sodic hypochlorite, and warm gently. A slow evolution of nitrogen takes place with effervescence, which is best observed by watching the liquid just after it has been withdrawn from the source of heat. A solution of nitrous acid in nitric acid gives a similar result.

BASES.

Of the large number of organic bases known, we have to consider only three, namely, Quinine, Morphine, and Strychnine. The following general remarks are only intended to be applied to these three, though in many cases they are equally applicable to the bases as a class.

These bodies are also called alkaloids, because in many of their reactions they behave like the alkali ammonia. It is most probable that they are derived from one or more molecules of ammonia, by replacing a part or all of the hydrogen by organic radicals.

GENERAL REACTIONS.

These reactions may be confirmed with either or all of the alkaloids available.

The alkaloids are sparingly soluble in water, but readily soluble in dilute acids, forming salts. Solutions of their salts are precipitated by alkalies.

Heated in a bulb-tube they readily blacken and give brown liquid distillates.

1. The alkaloids are precipitated by $PtCl_4$ from acid solutions as light yellow precipitates. Dilute solutions of morphine must be evaporated to get the reaction.

2. A solution of phospho-molybdic acid in nitric acid * precipitates the alkaloids from acid solutions as yellowish precipitates. The action of ammonia on these precipitates will be described under each individual alkaloid.

3. A solution of potassic iodide saturated with mercuric iodide gives yellowish-white, gelatinous or curdy precipitates with the alkaloids. Dilute acids do not prevent these reactions.

4. A solution of iodine in aqueous potassic iodide, gives with dilute acid solutions of the alkaloids, reddish-brown precipitates. These precipitates are decomposed by KOH, the morphine compound being soluble therein.

* This solution is prepared by dissolving in carbonate of soda solution the thoroughly washed precipitate obtained by adding sodic phosphate to the nitric acid solution of ammonic molybdate. The solution so obtained is evaporated to dryness, and ignited till no more ammonia is evolved, and the residue dissolved in water and nitric acid, taking care that the nitric acid is in large excess.

It should be observed that reactions 3 and 4 distinguish the salts of the alkaloids from salts of ammonia; that the second reaction does not distinguish them, except by the subsequent addition of ammonia; and that $PtCl_4$ also precipitates salts of ammonia, but the precipitate is far less easy to get, being more soluble, and is of a redder colour than the compounds formed by quinine and strychnine.

QUININE, $C_{20}H_{24}N_2O_2$.

1. Warm some sulphate of quinine with strong H_2SO_4. It dissolves, the solution gradually turns yellow, then blackens when the acid nearly boils. The solution does not thicken as it blackens.

2. To a solution of quinine (in dilute HCl) add NaOH. A white pulverulent precipitate of the free alkaloid is obtained, which is insoluble in excess of the reagent, but may be dissolved out by agitation with ether. AmOH gives a similar reaction.

3. To an acid solution of quinine add a few drops of sodic hypochlorite (or some good chlorine water), then AmOH in excess. A fine green colour is produced.

Repeat this experiment with a dilute solution of quinine, but before adding the AmOH, put in some solution of potassic (ferro- or) ferricyanide. The careful addition of the alkali will now produce a magnificent red colour, which changes in a few minutes to a reddish brown.

4. To a quinine solution add some phospho-molybdic acid solution; a yellow precipitate falls. Add now excess of AmOH; the yellow precipitate is changed to a much smaller white one.

MORPHINE, $C_{17}H_{19}NO_4$.

1. To a small quantity of morphine add strong H_2SO_4. If the acid is pure, there will be no colour produced in the cold, and on warming, a brown colour will be developed, which darkens as the heating is continued.

If the H_2SO_4 contains any nitric acid, the solution will develope a red colour on gently heating it. This colour is best obtained by first warming the morphine with strong H_2SO_4, then when nearly cold, adding a drop of HNO_3. So produced the colour is a rich red, inclining a little to purple, but soon passes into a lighter tint.

2. To a solution of a morphine salt add NaOH very carefully. A white crystalline precipitate is obtained readily soluble in excess of NaOH.

AmOH produces the same precipitate, difficultly soluble in excess, and Na_2CO_3 also precipitates the alkaloid insoluble in excess of the reagent. Morphine may therefore be precipitated from its solution in NaOH by acidifying, and then adding either AmOH carefully, or Na_2CO_3.

3. Put some solid morphine into a porcelain dish, and pour over it a few drops of Fe_2Cl_6. Triturate the morphine with a glass rod, and observe the blue colour produced. Divide this solution into two parts, and to one add HCl; the colour disappears at once. Warm the other; it gradually changes to a reddish brown; the blue colour returns on cooling it.

4. To an acid solution of morphine add the phospho-molybdic acid solution; a yellow precipitate falls. Add now AmOH; a deep blue solution is obtained. This reaction is highly sensitive and characteristic.

STRYCHNINE, $C_{22}H_{24}N_2O_2$.

1. Warm some strychnine with concentrated H_2SO_4. It dissolves without any change of colour, and blackens only very slightly even when the acid is heated to its boiling point.

2. To a solution of strychnine in HCl add NaOH; a white crystalline precipitate is obtained, which is insoluble in excess of the reagent.

If AmOH is used instead of NaOH, the precipitate dissolves readily in excess, but the solution soon begins to deposit the alkaloid in the form of silky needles.

3. Put a crystal of strychnine in a porcelain dish, add to it a drop or two of strong H_2SO_4. When solution has taken place, rub the liquid with a crystal of $K_2Cr_2O_7$, and a rich violet colour will be obtained, quickly passing through purple to red, then to reddish brown. Other oxidizing agents, such as peroxide of lead or ferricyanide of potassium, produce a similar play of colours. This reaction is very sensitive and characteristic.

4. To an acid solution of strychnine add the phospho-molybdic acid solution, and to the yellow precipitate obtained add excess of AmOH. The precipitate dissolves to a colourless liquid. In this reaction strychnine salts resemble ammonium salts.

Engagements for December.

December	1.	Linnean Society	8 p.m.
„	2.	Finance Committee of Orphanage, N.U.E.T.	7.30 p.m.
		Council of Orphanage, N.U.E.T.	8 p.m.
„	3.	Organisation Committee, N.U.E.T.	10 a.m.
		Meeting of Executive, N.U.E.T.	11 a.m.
„	5.	B.Sc. Exam. (Hon.) London University.	
„	7.	Geological Society	8 p.m.
		Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
„	8.	Royal Society	4.30 p.m.
„	9.	Finance of Prov. Society, N.U.E.T.	7 p.m.
		General Board, N.U.E.T.	8 p.m.
		New Shakspere Society	8 p.m.
„	12.	Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
		Education Society. 'Herbert Spencer's Educational Writings,' by Mrs. Bryant	7.30 p.m.
„	14.	Anthropological Institute	8 p.m.
„	15.	Linnean Society	8 p.m.
		York College Distribution of Prizes.	
		Royal Society	4.30 p.m.
„	16.	Meeting of Executive, N.U.E.T.	7 p.m.
		Finance Committee of Benev. N.U.E.T.	7 p.m.
		Browning Society, Paper by G. Barnett Smith, Esq.	8 p.m.
„	17.	Organisation Committee, N.U.E.T.	10 a.m.
„	19.	Central Committee of Benev. Fund, N.U.E.T.	7.15 p.m.
„	21.	Geological Society	8 p.m.
		Parliamentary and law Committee, N.U.E.T.	7.30 p.m.
„	22.	Royal Society	4.30 p.m.

CHRISTMAS SONG.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.

We beg to announce that any of the songs which have appeared in the back numbers of the PRACTICAL TEACHER may now be obtained separately, price 6d. per dozen, post free.

Pupil Teacher's Examination Questions.

OCTOBER, 1881.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the difference between the cost of 3,592 articles at £3 12s. 8d. each, and 3,683 articles at £2 4s. 11d. each.
2. If an 18-gallon cask of beer lasts for 4 weeks and 4 days, how many pints of beer are consumed in 3 days?
3. A person b ught 8 acres 1 rood 6 poles at £56 an acre, and 18 acres 2 roods 33 poles at £52 an acre, together with a farm-house worth a quarter of the price of the whole of the land. What amount of purchase money was required altogether?
4. I exchange 18 dozen of wine for a gold snuff-box weighing 8 oz. 13 dwts. 10 grs., valued at £4 10s. od. per oz.; at what do I value the wine per dozen?

FEMALES.

1. Make out the following bill:—
   81 lbs. of tea at 2s. 11d. per lb.
   99 lbs. of coffee at 1s. 7½d. per lb.
   54 lbs of cocoa at 1s. 5d. per lb.
   243 lbs. of rice at 2¼d. per lb.
   31 lbs. 8 oz. of butter at 1s. 10d. per lb.
   63 lbs. of loaf sugar at 7½d. per lb.
   108 lbs. of moist sugar at 3½d. per lb.
   38 lbs. 4 oz. of bacon at 10d. per lb.
   55 lbs. 2 oz. of cheese at 8d. per lb.
2. Find the cost of 14,773 acres 2 roods of land at £63 10s. 6d. an acre.
3. What is the value of 1,491 articles at £32 11s. 1d. each?
4. 30 cwt. 3 qrs. 9 lbs. 12 oz. at £16 6s. 8d. per cwt.

Grammar.

1. Parse all the verbs in the following:—

   'The king looked long upon her;
   "I would thou wert not here;
   Yet I refuse thee nothing,
   Because thou art so dear."
   Up sprang that joyous lady
   And eagerly she bade
   That they should loose the fetters
   Upon those captives laid.'

2. In what classes may adjectives be arranged? Give examples in each class.
3. What is meant by 'case'? What are the cases of nouns in English, and how do you distinguish them?

Geography.

1. Describe a coasting voyage from Gravesend to Southampton.
   If you can, draw a map of this portion of the coast.
2. The subject for a prize theme at a school was:—
   '*Which is the finest river in Great Britain?*'
   Four boys tried for the prize; one born in London, one in Glasgow, one in Perth, one in Welshpool; and each chose his own river. What did each find to say? And which do you think ought to have got the prize?
3. Name six important towns in Ireland. Describe fully the situation of each, and mention any circumstances connected with them.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

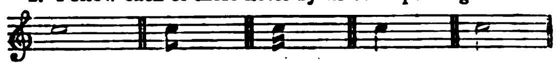
Write, in large hand, as a specimen of copy-setting, the word *Witherslack*.

Write, in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

Music.

1. Write, over each of the following notes, its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other).

2. Follow each of these notes by its corresponding rest.



3. How many tones and semitones are found in a major scale, and what places therein do the latter occupy?

ANSWERS.—CANDIDATES.

Arithmetic.

MALES.

		£	s.	d.
1. (*a*)	Value at £1 ... ... =	3592	0	0
				3
,,	£3 ... ... =	10,776	0	0
,,	10s. = ½ value at £1 =	1796	0	0
,,	2s. = ⅕ ,, 10s. =	359	4	0
,,	8d. = ⅓ ,, 2s. =	119	11	8
,,	£3 12s. 8d. =	13,050	18	8
		£	s.	d.
(*b*)	Value at £1 ... ... =	3683	0	0
				2
,,	£2 ... ... =	7366	0	0
,,	5s. = ¼ value at £1 =	920	15	0
		8286	15	0
less ,,	1d. = $\frac{1}{60}$,, 5s. =	15	6	11
		8271	8	1

diff. of (*a*) and (*b*) = (£13,050 18s. 8d. − £8271 8s. 1d.) = £4779 10s. 7d. Ans.

2. 18 galls. or 144 pts. for 32 days = 4½ pts. for 1 day.
∴ they consume 4½ × 3 or 13½ pts. in 3 days.

		£	s.	d.
3. (*a*)	Value of 1 ac. ... ... =	56	0	0
				8
,,	8 ac. ... ... =	448	0	0
,,	1 rd. = ¼ value of 1 ac. =	14	0	0
,,	5 po. = ⅛ ,, 1 rd. =	1	15	0
,,	1 ,, = ⅕ ,, 5 po. =	0	7	0
,,	8 ac. 1 rd. 6 po. =	464	2	0
		£	s.	d.
(*b*)	Value of 1 ac. ... ... =	52	0	0
				18
,,	18 ac. ... ... =	936	0	0
,,	2 rds. = ½ val. of 1 ac. =	26	0	0
,,	20 po. = ¼ ,, 2 rds. =	6	10	0
,,	10 ,, = ½ ,, 20 po. =	3	5	0
,,	2 ,, = ⅕ ,, 10 ,, =	0	13	0
,,	1 ,, = ½ ,, 2 ,, =	0	6	6
,,	18 ac. 2 rds. 33 po. =	972	14	6
		464	2	0
	Sum of (*a*) and (*b*) =	1436	16	6
	and ¼ of ,, ,, =	359	4	1½
	∴ the purchase money =	1796	0	7½ Ans.

		£	s.	d.
4.	Value of 1 oz. ... ... =	4	10	0
				8
,,	8 oz. ... ... =	36	0	0
,,	10 dwts. = ½ value of 1 oz. =	2	5	0
,,	3⅓ ,, = ⅓ ,, 10 dwt. =	0	15	0
,,	2 grs. = $\frac{1}{40}$,, 3⅓ ,, =	0	0	4½
,,	8 oz. 13 dwts. 10 grs. =	39	0	4½
	∴ 18 doz. costs	39	0	4½
	and 1 ,, ,, ...	2	3	4¼ Ans.

FEMALES.

							£	s.	d.	
1.	81 lbs.	at	2s. 11d.	per lb.	...	=	11	16	3	
	99	,,	1s. 7½d.	,,	...	=	8	0	10½	
	54	,,	1s. 5d.	,,	...	=	3	16	6	
	243	,,	0s. 2¾d.	,,	...	=	2	15	8¼	
	31½	,,	1s. 10d.	,,	...	=	2	17	9	
	63	,,	0s. 7½d.	,,	...	=	1	19	4½	
	108	,,	0s. 3½d.	,,	...	=	1	11	6	
	38¼	,,	0s. 10d.	,,	...	=	1	11	10½	
	55⅛	,,	0s. 8d.	,,	...	=	1	16	9	
							36	6	6¾	Ans.

			£	s.	d.	
2.	Value of land at £1 per ac. ...	=	14773	10	0	
					7	
			103414	10	0	
					9	
,,	£63 ,,	=	930730	10	0	
,,	10s. = ½ at £1	=	7386	15	0	
,,	6d. = $\frac{1}{20}$,, 10s.	=	369	6	9	
,,	£63 10s. 6d.	=	938486	11	9	Ans.

			£	s.	d.	
3.	Value of whole at £1	=	1491	0	0	
					4	
			5964	0	0	
					8	
,,	£32	=	47712	0	0	
,,	10s. = ½ val. at £1	=	745	10	0	
,,	1s. = $\frac{1}{10}$,, 10s.	=	74	11	0	
,,	1d. = $\frac{1}{12}$,, 1s.	=	6	4	3	
	£32 11s. 1d.	=	48538	5	3	Ans.

			£	s.	d.	
4.	Value of 1 cwt.	=	16	6	8	
					6	
			98	0	0	
					5	
,,	30 cwt.	=	490	0	0	
,,	2 qrs. = ½ value of 1 cwt.	=	8	3	4	
,,	1 ,, = ½ ,, 2 qrs.	=	4	1	8	
,,	7 lbs. = ¼ ,, 1 ,,	=	1	0	5	
,,	2 ,, = $\frac{1}{14}$,, 1 ,,	=	0	5	10	
,,	8 oz. = ¼ ,, 2 lbs.	=	0	1	5½	
,,	4 ,, = ½ ,, 8 oz.	=	0	0	8¾	
,,	30 cwt. 3 qrs. 9 lbs. 12 oz.	=	503	13	5¼	Ans.

Grammar.

1. *looked*—intrans. reg. verb, indic., past indef., 3rd pers. sing., agreeing with subj. *king*.
   would—defective verb (*will, would*), indic., past indef., 1st pers. sing., agreeing with subj. *I*.
   wert—irreg. substantive verb *am, was, been*, subjunctive, past indef., 2nd pers. sing., agreeing with subj. *thou*.
   refuse—reg. trans. verb, indic., pres. indef., 1st pers. sing., agreeing with subj. *I*.
   art—irreg. subj. verb, *am, was, been*, indic., pres. indef., 2nd pers. sing., agreeing with subj. *thou*.
   sprang—intrans. verb, strong con., *spring, sprang, sprung*, indic., past indef., 3rd pers. sing., agreeing with subj. *lady*.
   bade—trans. verb, strong con., *bid, bade, bidden*, indic., past indef., 3rd pers. sing., agreeing with subj. *she*.
   should—defect. auxiliary verb, *shall, should*, indic., past indef., forming with the infinitive of reg. verb,
   loose—the past indef. potential, 3rd pers. plur. agreeing with subj. *they*.
   laid—complete part. of *lay, laid, laid*, agreeing with *fetters*.
2. Adjectives may be arranged in *three* classes—
   (1) Adjectives of *quality*, e.g., *good, old, red, beautiful*.
   (2) ,, *quantity*, e.g., *one, two, little, much*.
   (3) ,, *distinction*, e.g., *first, this, each, next, my*.
3. *Case* is an inflexion of nouns and pronouns for showing the relation which they bear to other words. The cases of nouns in English are (1) the *Nominative*, which is used to express the *subject* of a sentence, as *I* smiled, *He* sang.

(2) The *Possessive*, used to show the possessor of something, as, *John's* hat, the *boy's* cap; (3) the *Objective*, used when the noun or pronoun is acted upon by a verb, or when it is the object of a relation (governed by a preposition), as, He strikes the *door* with a *stick*; 'I know *him* of *whom* you speak.'

Note.—When a person is addressed, the noun is sometimes said to be in the Vocative case, as '*John*, come here,' and the noun or pronoun in such sentences as 'Give *him, them, John*, etc., some money' is also said to be in the *Dative* case. The Dative case (or indirect object) also occurs after such words as *like, next, near*, etc., as '*like* him,' 'next them.'

Geography.

1. Starting from *Gravesend*, a great summer resort, we come to *Sheerness*, a fort built after the insult of the Dutch, 1667, and then to the much-frequented watering-places *Margate* and *Ramsgate*. This part of Kent used to be separated from the mainland by the Stour, and was called the *Isle of Thanet*. Passing *Sandwich* we come to *Deal*, with its many boatmen and pilots, who depend for a living on the shipping which resort to the *Downs* lying between the shore and the *Goodwin Sands*. *Dover* is a busy port, having great passenger traffic with the Continent. On this coast were the original Cinque Ports established by the Conqueror, *Sandwich, Dover, Hythe, New Romney*, and *Hastings*. Sailing west we reach *Hastings*, near the famous battlefield of 1066; and *Brighton*, a beautiful town, and a favourite resort of George IV. Passing *Selsea Bill* we come to *Spithead*, the safest roadstead in England, and after visiting *Portsmouth*, with its famous dockyard and fortifications, we arrive at our destination *Southampton*, a very important packet station to the West Indies and the Mediterranean.

2. The *Thames*, rising in the Cotswold Hills, has a basin not consisting of only one valley but of many, all opening into the largest valley. The various secondary river-systems are separated from one another by intervening higher lands, penetrating far in the general level of the drainage. This system of valleys gives a beautiful diversity of hill and dale, that renders the Thames scenery very pleasing; and in the upper part of its basin the country is well suited for the production of grain and dairy produce. The Thames above London is noted for the purity of its waters, and its current is neither rapid nor sluggish. Though it may not excel some rivers in the beauties of Nature it is the chief river of Great Britain, has the largest city in the world on its banks, and is commercially by far the most important on the face of the globe. Few rivers can boast of such places as *Oxford, Eton, Windsor, Richmond, Chelsea, Greenwich, Woolwich, Chatham*, and *Sheerness*, which both enhance its natural attractions, and give the stream a classic character.

The *Clyde* rises in the Lowther Hills, and after its union with the Douglas forms a succession of beautiful cataracts, the chief being the magnificent falls of Cora Lin. It afterwards takes a north-west course through a comparatively well-cultivated district, and after receiving several tributaries, spreads out at Dumbarton into a broad estuary. Few rivers, it has been said, can boast of scenery of greater variety or of greater beauty than the Clyde. Above Glasgow, its course is now through verdant lawns, now through rocky defiles, and now between steep and gorgeously wooded banks. Below Glasgow, where it widens into an estuary, lofty hills rise on every side, and bound the far distance. Lochs or arms of the sea branch off at various points on the north and west, carrying the eye of the tourist into mountain valleys, while the shores are studded with beautiful villas and watering-places, the resort not only of Glasgow citizens but of visitors from all parts of Britain. The whole presents a panorama of unequalled beauty, grandeur, and magnificence, an attraction to painters and lovers of nature from all parts of the earth.

The *Tay*, rising in the Southern Grampians, flows in a north-easterly direction expanding into the beautiful Loch Tay. It is afterwards joined by the Tumel, which is acknowledged to be one of the finest of Scottish rivers. After receiving the Tumel, the Tay flows south, and the scenery is very picturesque, and continues so till two miles south of Dunkeld. It then traverses a well-cultivated and fertile country, and enters the German Ocean below Dundee, where it was crossed by an iron bridge, a wonderful structure, which came to grief in the storm of 1879. The Tay is fed by some very picturesque tributaries, and is known to be the finest salmon river in Great Britain. Its basin is bounded by the Grampians, Ochil, and Sidlaw Hills. Perth, an ancient city on its banks, has one of the finest situations of any town in Scotland, and the view from Kinnoul hill gives a picture of the valley of the Tay which is admired for its beauty.

The *Severn* rises on the east side of Plinlimmon, under the name of the Hafren, 'queen of rivers.' At Newton it receives the name of Severn, flows through the beautiful vale of Mont-

gomery, and continues on through a series of almost unrivalled vales, pursuing its romantic course through the counties of Salop, Worcester, and Gloucester. The nature of the Welsh country precludes the possibility of extensive plains, but gives the valleys generally a narrow rugged form, which is particularly favourable to romantic beauty. These valleys, respectively known as the vale of Worcester, the vale of Gloucester, and the vale of Berkeley, are not only distinguished for their great natural beauty but also for their fertility.

3. *Dublin* is the capital of Ireland on the Liffey. Its castle is the residence of the Lord-lieutenant. Besides being the seat of government, Dublin is the seat of the Irish law-courts, of a university, and of various learned and scientific bodies. The magnificence of its cathedral and public buildings entitle it to rank as one of the finest cities in Europe. Its jail, Kilmainham, has become famous under the Coercion Act.

Belfast lies on the north side of the Lagan at the head of Belfast Lough. It is next to Dublin in respect of population, and one of the most rapidly rising towns in the whole kingdom. Belfast is the centre of the Irish linen trade, as well as the chief seat of both the linen and cotton manufactures of Ireland. In an island on the Lagan is an iron ship-building yard, from which have been launched some of the finest vessels afloat. One of the Queen's colleges of Ireland is situated in Belfast.

Cork is the principal town in the south, on one of the safest and finest harbours in Europe. It possesses great trade in the export of grain and all sorts of provisions. It is the seat of one of the Queen's colleges. The port of Cork formerly known as the Cove, is now called Queenstown in honour of the Queen's visit in 1849.

Limerick stands at the head of the estuary of the Shannon, carries on important linen and other manufactures, and is the leading port on the west coast for the export of raw produce. Famous for its siege (1690-91).

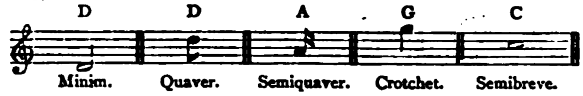
Galway is at the mouth of the Corrib in Galway Bay, has also considerable trade in raw produce, and is the seat of one of the Queen's colleges.

Londonderry, the principal port on the north coast, stands at the head of L. Foyle. It sustained a memorable siege against the whole Irish forces of James II. (1688-89).

Music.

1.

D D A G C



Minim. Quaver. Semiquaver. Crotchet. Semibreve.

2.

3. Five tones and two semitones, the latter being found between the 3rd and 4th, and 7th and 8th notes of the scale.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the value of 112 oz. at £$\frac{17}{60}$ per cwt.

2. If the poor rate paid on a house rated at £63 be £2·390625, what amount of poor rate ought to be paid in £ s. d. on a farm rated at £272?

3. Find by decimals and by vulgar fractions, the difference between $\frac{1}{8}$ and $\frac{1}{15}$ of half a crown, and reduce it to the decimal of half a guinea.

4. Compare the values of ·875 of 5s. 3d., and ·785 of 6s. 8d.; and state the difference.

5. One-third of a package of cloth is sold at 2s. 6d. a yard; one-fourth of it at 1s. 6d. a yard; the remaining 25 yards at 1s. 10d. a yard, gaining by the whole transaction 2d. a yard on the cost price. Find the whole gain.

FEMALES.

1. A bill for gas being £5 9s. 3d., when gas was at 4s. 9d. per 1000 ft.; what will it be when the price of gas is increased by 1s. 6d. per 1000 ft.?

2. If 6 men can reap 16 acres in 4 days, working 10 hours a day, in how many days will 10 men reap 24 acres, working 12 hours a day?

3. A number of men built a wall 50 yds. long in 20 days of 12 hours each, in how many days of 10 hours each could they have completed it?

4. If after paying income tax at 1s. 2d. in the pound, a gentleman has £701 10s. 10d. remaining, what is his annual income?

Grammar.

1. Parse all the pronouns in the following passage:—

'Once more my sire's abode
Is mine, behold the floor I trode
In tottering infancy!
And there the vaulted arch whose sound
Echoed my joyous shout and bound
In boyhood, and that rang around
To youth's unthinking glee.'

2. Pronouns admit of more inflexions than nouns. Prove by examples that this is so.

3. Prepositions are said to indicate relations of place, of time, of causality. Give examples of prepositions indicating each relation.

Geography.

Answer Q. 1, *or* Q. 3, *not both.*

1. The subject for a prize-theme at a school was:—*Which is the finest river in Europe?*

Four boys tried for the prize, one born at Seville, one at Lyons, one at Cologne, one at Buda-Pesth; and each chose his own river. What did each find to say? And which do you think ought to have got the prize?

2. Draw a full map of Italy.

3. Name six important towns in Ireland, and say what you know of each.

History.

1. Write down a list of our kings from Egbert to Ethelred, with dates.

2. Give the dates of William I., Henry II., Edward I., and Richard II., and name their immediate successors.

3. Write out a list of our sovereigns from 1625 to 1714, with dates.

Penmanship.

Write in large hand, as a specimen of copy-setting, the word, *Withenslack.*

Write in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

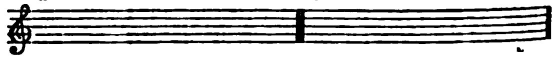
Composition.

Write from memory the substance of the passage read to you by the Inspector.

Music.

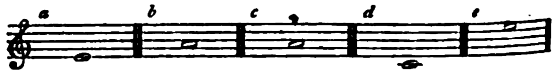
1. Write in *a* the scale of A (*La*), and in *b* the scale of E♭ (*Me*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

a *b*



2. Place its second below *a*, its third below *b*, its fourth above *c*, its fifth above *d*, and its octave below *e*.

a *b* *c* *d* *e*



3. How many semiquavers are equal (in length) to one minim?
How many quavers are equal (in length) to one semibreve?
How many crotchets are equal (in length) to one dotted minim?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. 1 cwt. or 1792 oz. cost £$\frac{17}{60}$ or 68d.
1 oz. „ 68d. ÷ 1792
∴ 112 oz. „ 68d. × $\frac{112}{1792}$
i.e. or 4¼d. Ans.

2. £63 pay a rate of £2·390625 or £2 7s. $9\frac{3}{8}$d.
£1 ,, £2 7s. $9\frac{3}{8}$d. ÷ 63
∴ £272 ,, £2 7s. $9\frac{3}{8}$d. × $\frac{272}{63}$
i.e. $9\frac{3}{28}$d. × 272 = £10 6s. $5\frac{1}{7}$d. Ans.

3. $\frac{1}{6}$ of 30d. = $\frac{5}{30}$ or ·16 of 30d.
$\frac{1}{15}$,, = $\frac{2}{30}$,, ·06 ,,
∴ the diff. = $\frac{1}{10}$,, ·1 of 30d., *i.e.* 3d. which is $\frac{3}{126}$ of 10s. 6d. or $\frac{1}{42}$, and this fraction reduced to a decimal = ·0238095. Ans.

4. (*a*) ·785 = $\frac{785}{1000}$ = $\frac{157}{200}$; and $\frac{157}{200}$ of 6s. 8d. = 5 $2\frac{4}{5}$
(*b*) ·875 = $\frac{875}{1000}$ = $\frac{7}{8}$; and $\frac{7}{8}$ of 5s. 3d. = 4 $7\frac{5}{40}$
∴ (*a*) is greater than (*b*) by 0 $7\frac{27}{40}$d.

5. $\frac{1}{3}$ + $\frac{1}{4}$ = $\frac{7}{12}$; ∴ 25 yds. = $\frac{5}{12}$ of the whole, and the whole = 25 × $\frac{12}{5}$ = 60 yds.
∴ A gain of 2d. per yd. gives 60 times 2d. or 10s.

5. If it mean that the 60 yds. were bought at 1s. 8d. per yd. then the whole gain = (20 yds. at 2s. 6d.) + (15 yds. at 1s. 6d.) + (25 yds. at 1s. 10d.) − (60 yds. at 1s. 8d.) = £5 18s. 4d. − £5 0s. 0d. = 18s. 4d.

FEMALES.

1. At 57d. per 1000 ft. the cost is £5 9s. 3d.
1d. ,, ,, 1311d. ÷ 57
∴ 75d. ,, ,, 1311d. × $\frac{75}{57}$
i.e. 23d. × 75 = £7 3s. 9d.

2. $\left.\begin{array}{l}\text{10 men : 6 men}\\ \text{16 ac. : 24 ac.}\\ \text{12 ho. : 10 ho.}\end{array}\right\}$ :: 4 days : days required.
4 days × $\frac{6}{10}$ × $\frac{24}{16}$ × $\frac{10}{12}$ = 3 days.

3. Working 12 ho. a day they take 20 days
,, 1 ,, ,, 20 days × 12
,, 10 ,, ,, 20 days × $\frac{12}{10}$ or 24 days.

4. The sum of 18s. 10d. is got from £1
,, 1d. ,, £1 ÷ 226
∴ £701 10s. 10d. or 168370d. ,, £1 × $\frac{168370}{226}$ or £745.

Grammar.

1. *My*—pronominal poss. adj. attributive to *sire*.
mine—personal pron. 1st pers. masc. sing. poss., attributive to (*abode*.)
I—personal pron. 1st pers. masc., sing. nom., subj. of *trode*.
whose—simple relative pron. referring to *arch*. neut. sing., poss., attributive to *sound*.
my—*as before* attrib. to *shout*.
that—simple rel. pron., referring to *arch*, neut., sing., nom., subj. of *rang*.

2. That pronouns have more inflexions than nouns, may be seen by comparing the inflexions of *man* with the pronoun *he*, which is that noun's substitute.

	Sing	*Plural*	*Sing*	*Plural*
Nom.	man	men	He	They
Poss.	man's	men's	his	theirs
Obj.	man	men	him	them

In the above examples '*man*' becomes *man's*, *men*, *men's*, whereas 'he' becomes *his*, *him*, *they*, *theirs* and *them*.

3. Prepositions of *place*:—*in*, *on*, *at*, *by*, *under*, etc., as 'a horse *in* the stable;' 'a field *by* a river.'

Of *time*:—*after*, *before*, during, till, etc., as, He arrived after three o'clock, before six, during a storm.

Of *course*:—*from*, *with*, *by*, of. He died *of* hunger, *by* the sword, *from* want.

Geography.

1. The *Guadalquivir* rising on the borders of Granada flows in a southwesterly direction to the Atlantic, having for its basin the whole plain of Andalusia bounded on either side by the Sierra Morena and the Sierra Nevada. Though its length is but 350 miles, yet it flows through one of the most lovely valleys, of which the following is a description. 'The plains of Andalusia, notwithstanding their being situated in one of the warmest climates of Europe, are still, generally speaking, of a moderate temperature. In them are found myrtles, palm trees, olives, bananas, orange and lemon trees, with other productions of a warm climate, and in some spots the sugar cane and cotton grow. The orange and lemon trees, particularly around convents, form groves of considerable extent, which, in the time of blossoming send forth a most delicious perfume. At that season the inhaling of these odours gives a delightful sensation of the salubrity of the air. The soil is so productive that the husbandman with very little trouble can raise an abundant harvest. The river, therefore, seems to flow through an earthly paradise.

The *Rhone* rising in Mount St. Gothard flows south-west to its confluence with the Drance at Martigny, where is the road to the grand scenery of the Alps. It then enters L. Geneva as a muddy stream, but on leaving this beautiful lake it is of the finest blue. It immediately enters a rocky gorge, where it is lost to view, flows past Mont Cenis, and then bends to the westward to join the Saone. From this point it flows south to the Mediterranean through a valley whose slopes are almost everywhere planted with vines, forming some of the finest vine-yards of France. It traverses some beautiful districts well adapted for the cultivation of the mulberry, and so the silkworm thrives and causes this part of France to be the best silk-producing portion of the country. These facts, combined with the passing of the upper course of the river through the picturesque Canton of Vallais, and its enlargement to form Lake Geneva, of world-wide fame and historical interest, render the Rhone a stream having no mean claim to be one of the finest, as it is the most rapid river in Europe.

The *Rhine* rises in Mount St. Gothard, takes a north-east direction through the magnificent ravine of the Rheinwald enclosed with rocks 3,000 feet high, and covered to their summits with firs. It unites with another stream and flows through a romantic valley to Lake Constance, after leaving which lake it forms the magnificent and renowned falls of Schaffhausen. At Basle the Rhine turns north and flows onward to empty itself by a delta into the North Sea. Of this beautiful river it has been said that from its source to Basle, wildness, grandeur, and romantic beauty characterize it in every part. But the scenery most generally admired lies between Mentz and Bonn. The Rhine here pursuing a meandering course is pent between lofty and craggy mountains, and resembling rather a succession of lakes than a river. These mountains are mountains in miniature, with groves now and again on their sides, each grove having a church spire rising in its midst, and overtopping the trees. Frequently an ancient castle crowns some fantastic cliff and frowns over the river, or rises majestically from the brow of the steep.

The *Danube* is a river of the first rank, and the second of European rivers, being only inferior to the Volga. Its course is calculated to be about 1770 miles, and it drains a surface at least 300,000 square miles in area. It is augmented by 60 large tributary rivers, and passes into the Black Sea, nearly as great a volume of water as all the other rivers that flow into that sea. Geographers divide the course of the river into three parts. Its upper course is through the hilly country about its source, the Bavarian plain, and the mountains which divide that plain from the plains of Hungary; the middle course extends from Vienna to the 'Iron Gate,' which divides the Hungarian from the Wallachian plain; and the lower course traverses the last-mentioned plain. The upper course passes through the far-famed scenery of the Black Forest, and the wide and fertile plains of Bavaria, rich in corn, flax, and fruits, and even here the river by means of steam navigation promotes internal communication. The middle course flows through a district which excels almost any country in Europe for natural productions. The Hungarian wheat is of the finest quality and well known in the French and English markets: the breed of horned cattle is one of the finest in Europe, and the yearly production of Hungarian wine is something enormous. Below Belgrade where the Danube is joined by the Save, the river flows for sixty miles through an undulating tract, until its bed is narrowed by the approach of the Carpathians and Balkans. Near the termination of this defile is the famous pass of the 'Iron Gate,' a deep gorge 2000 yards long, enclosed on either side by mountains of slate, and through which the river rushes with great velocity, and a deafening noise. With the exception of the delta, and its course between Bulgaria and Wallachia, the scenery on the Danube is picturesque and impressive, at one time flanked by mountains, and again by far extending forests.

3. *See same question under 'Candidates' in this number of magazine.*

History.

			A.D.
1.	Egbert began to reign		827
	Ethelwulf	,,	836
	Ethelbald	,,	857
	Ethelbert	,,	860
	Ethelred I.	,,	866-871

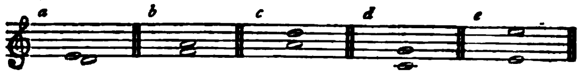
2.		A.D.			A.D.
William I.	began to reign	1066;	suc. by	William II. (Rufus)	1087
Henry II.	,,	1154;	,,	Richard II.	1189
Edward I.	,,	1272;	,,	Edward II.	1307
Richard II.	,,	1377;	,,	Henry IV.	1399

			A.D.
3.	Charles I. began to reign		1625
	(*Commonwealth intervened from* 1649-60)		
	Charles II.	restored	1660
	James II.	succeeded	1685, dethroned 1688
	William III. and Mary II.	"	1689
	Anne	"	1702
	George I	"	1714

Music.

1.

2.



3. Eight.
Eight.
Three.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. If an army when reduced 15·8 per cent. by sickness number 8841 men, what was the original number of the army?

2. Find simple interest on £34,675 for 17 days at 5 per cent. per annum?

3. If £189 16s. 6d. amounts to £211 8s. $4\frac{89}{400}$d. in three years and a half, at simple interest, what is the rate per cent. per annum?

4. A man who has a house worth £3000 insures it at $\frac{3}{5}$ of its value at 3s. 3d. per cent., what yearly premium does he pay?

5. The $3\frac{1}{2}$ per cents. are at $95\frac{5}{8}$; I wish to derive an income of £280 from investing in them; what amount of money shall I require?

FEMALES.

1. Reduce $7\frac{3}{4} - 4\frac{5}{12} - \frac{2}{21} + 1\frac{3}{28}$ to its lowest terms.

2. Express $\frac{3}{8}$ of $\frac{5}{17}$ of £1 14s. + $\frac{5}{8}$ of $\frac{1}{4}$ of £1 10s. + $8\frac{4}{7}$ of $\frac{1}{11}$ of 5s. as the fraction of £20.

3. The factors of a certain number are $\frac{7}{15}$, $2\frac{1}{7}$, $\frac{11}{14}$, and $5\frac{1}{4}$; what is $3\frac{3}{5}$ of $\frac{2}{21}$ of $\frac{5}{8}$ of the number?

4. I sold a house to A for $\frac{1}{5}$th more than it cost me. A sold it again to B for £18 13s. 4d., which was $\frac{1}{6}$th less than it cost him. What did the house cost me?

Grammar.

1. 'The *service done*, the mourners stood *apart*; he called to mind how he had seen her *sitting* on that *very* spot, and how her book had *fallen* on her lap as she was gazing with a pensive face upon the sky. *Another* told how he had wondered *that one* so *delicate* as she, should be so bold; how she had *never feared* to enter the church *alone* at night.'

(*a.*) Point out the 'subordinate' conjunctions in the above. State to which class of subordinate conjunctions each belongs, and show why such conjunctions are called subordinate.

(*b.*) Parse the words in italics.

2. How can you tell when the following words are used as adverbs, and when as conjunctions—*after, before, since?* Give examples of them in both uses.

Geography.

ANSWER Q. 1 *or* Q. 3; *not both.*

1. The subject for a prize-theme at a school was:—'*Which is the finest river in Europe?*' Four boys tried for the prize; one born at Seville, one at Lyons, one at Cologne, one at Buda-Pesth, and each chose his own river. What did each find to say; and which, do you think, ought to have got the prize?

2. Draw a full map of Hindostan.

3. Name six important places in British North America, and say what you know of each.

SECOND PAPER.

One hour allowed for Females.
Two hours and a half allowed for Males.

History.

1. What was the hereditary kingdom of Alfred? For what services to his country does this prince deserve to be called 'the Great'?

2. Why is the mother of Henry II. known as 'the Empress' Maud? Who was her second husband, and what line of kings descended from that union?

3. The later years of Edward III. were darkened by disputes between the barons and the commons and between the barons and the clergy; give some account of these disputes.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Witherslack.*

Write, in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

Composition.

Write full notes of a lesson on *A Manufacturing Town.*

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation* are not admissible.]

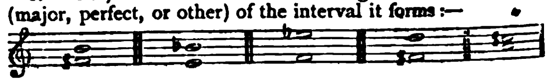
1. Upon the same base, and on the same side of it, there cannot be two triangles that have their sides which are terminated in one extremity of the base, equal to one another, and likewise those which are terminated in the other extremity.

2. If two triangles have two sides of the one equal to two sides of the other, each to each, but the angle contained by the two sides of one of them greater than the angle contained by the two sides equal to them of the other; the base of that which has the greater angle, shall be greater than the base of the other.

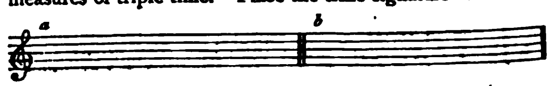
Show that without the restriction in the construction there would be three cases.

Music.

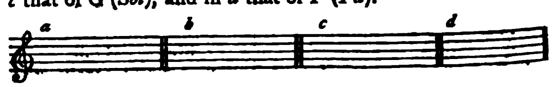
1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms:—



2. Write in *a* two measures of common time, and in *b* two measures of triple time. Place the time signature before each.



3. Write in *a* the signature of D (*Re*), in *b* that of B♭ (*Si*), in *c* that of G (*Sol*), and in *d* that of F (*Fa*).



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. A loss of 15·8 p.c. leaves $\frac{84\cdot2}{100}$ of the whole, ∴ the whole =

$$8841 \times \frac{100}{84\cdot2} = \frac{884100}{842} = \underline{10500} \text{ men. Ans.}$$

2. Simple interest = £34,675 × $\frac{17}{365}$ × $\frac{5}{100}$ =

$$£\frac{346\cdot75 \times 17}{73} = £4\ 15s. \times 17 = \underline{£80\ 15s.} \text{ Ans.}$$

3.

	£	s.	d.
Amount =	211	8	$4\frac{89}{400}$
Principal =	189	16	6
∴ Interest =	21	11	$10\frac{89}{400}$

$$\therefore \text{rate p. c.} = £21\ 11s.\ 10\tfrac{89}{400} \times \frac{1}{3\frac{1}{2}} \times \frac{£100}{£189\ 16s.\ 6d.} =$$

$$£\frac{2072889}{400 \times 240} \times \frac{2}{7} \times \frac{100 \times 240}{45558} = £[illegible] = \underline{£3\tfrac{1}{4}}.$$

4. $\frac{3}{5}$ of £3000 = £1800; Premium on £100 = 3s. 3d.
∴ " £1800 = $\underline{£2\ 18s.\ 6d.}$

5. $£3\frac{1}{2}$ are got from $£95\frac{3}{8}$

$\therefore £280$,, $£95\frac{3}{8} \times \frac{280}{3\frac{1}{2}}$

,, ,, $£\frac{763 \times 560}{8 \times 7}$

i.e. $£109 \times 70 = \underline{£7630.}$ Ans.

FEMALES.

1. $7\frac{3}{4} - 4\frac{5}{12} - \frac{2}{21} + 1\frac{3}{42} = (7\frac{9}{12} - 4\frac{5}{12}) = 3\frac{1}{3}$;
$(3\frac{7}{21} - \frac{2}{21}) = 3\frac{5}{21}$; $(3\frac{10}{42} + 1\frac{3}{42}) = \underline{4\frac{13}{42}}$.

2. (*a*) $\frac{4}{9}$ of $\frac{9}{17}$ of £1 14s. $= \frac{4}{17}$ of 34s. $=$ 8 s.
$\frac{5}{8}$ of $\frac{1}{6}$ of £1 10s. $= \frac{30s. \times 5}{6 \times 8} = 3\frac{1}{8}$
$8\frac{1}{4}$ of $\frac{1}{11}$ of 5s. $= \frac{5s. \times 33}{4 \times 11} = 3\frac{3}{4}$
Total $= 14\frac{7}{8}$.

(*b*) $14\frac{7}{8}$s. to the fraction of $£20 = \underline{\frac{119}{3200}}$.

3. The number may be represented by $(\frac{7}{12} \times \frac{21}{8} \times \frac{11}{14} \times \frac{21}{4})$ and
$\therefore \frac{32}{9}$ of $\frac{8}{21}$ of $\frac{3}{5}$ of $\frac{7}{12} \times \frac{21}{8} \times \frac{11}{14} \times \frac{21}{4} =$
$$\frac{32 \times 8 \times 3 \times 7 \times 21 \times 11 \times 21}{9 \times 21 \times 5 \times 12 \times 8 \times 14 \times 4} = \underline{5\frac{2}{15}}.$$

4. A must have bought the house for $\frac{7}{6}$ of original price, and he sold it to B for $\frac{5}{6}$ of $\frac{7}{6}$ original price, *i.e.* $\frac{35}{36}$ of original price, and $\therefore$ cost price $= £18$ 13s. 4d. $\times \frac{36}{35} = \underline{£19\ 4s.}$

Grammar.

1. The only subordinate conjunctions in the given passage are, (4) 'how,' (1) 'that,' and (2) 'as.' 'How' (= that), and 'that' may be called *simple* cunjunctions of subordination, 'as' (1) (= while) is a conjunctive-adverb or *adverbial*-conjunction, and 'as' (2) is a *comparative* conjunction.

Subordinate conjunctions are those which unite sentences o lwhich one is in a relation of dependence upon the other, that is to say, enters into its construction with the force of a substantive or an adverb.

(*b*) *service*—abst. noun, neut., sing., forming with
done—complete part., of *do, did, done* the nom. absolute.
apart—adv. of place modifying *stood*.
sitting—incomplete part, of irreg. intrans. v. *sit, sat, sat* agreeing with *h.r.*
very—disting., adj., pointing to *spot*.
fallen—complete part. of irreg. intrans. v. *fall, fell, fallen*, forming with *had*, a compound tense.
another—indef. pron. 3rd pers. sing., mas., nom. subj. of *told*.
that—a simple conjunction of subordination introducing the subord. sent., '*one should be so bold*.'
one—indef. pron., 3rd. pers., sing., fem., nom., subj. of *should*.
delicate—adj. of quality, qual., *one* (used predicatively.)
feared—complete part. of reg. intrans. v., *to fear* forming with *had* a compound tense.
alone—adv. of manner mod. *to enter*.

2. *After, before,* and *since* when conjunctions stand at the beginning of the clauses which they govern as, 'I hope to hear from you—*after* you return,'—'*before* you leave'—'*since* you must go.' As adverbs they modify the meaning of the verb 'I shall go *before*.' 'You can follow *after*.' I have not seen him *since*.

Geography.

1. *See same question answered under 'First Year' in this number of Magazine.*

3. *Ottawa*. Seat of Government of the Dominion of Canada —in the province of Ontario—formerly called Bytown—stands at the junction of the Rideau Canal with the Ottawa.

Quebec is the capital of the province of Quebec—on the north bank of the river St. Lawrence—is very strongly fortified, and has an extensive trade. Taken from the French by Wolfe, in 1759.

Montreal, in the province of Quebec, on the S. E. side of the island of Montreal at the confluence of the St. Lawrence and the Ottawa, has a thriving trade, and close to it is the tubular bridge, $1\frac{1}{4}$ miles in length, which carries the Grand Trunk Railway over the St. Lawrence.

Halifax, the capital of Nova Scotia, on the S. E. coast, has an extensive trade, and its noble harbour is the chief naval station of British America.

St. John's, chief town of Newfoundland, on the S. E. coast, is strongly fortified, and has a great trade in connection with the cod fishery.

St. John, the principal seaport of New Brunswick, on the Bay of Fundy, at the mouth of the river St. John, suffered greatly by fire four years ago (1877).

History.

1. The hereditary kingdom of Alfred was *Wessex*. He is entitled to the name 'Great' from the following considerations. In addition to the military organisation of the country, Alfred did much to improve the social condition of his subjects; established schools, and translated many Latin books into Anglo-Saxon for the instruction of the people; wrote several historical and geographical works; invited learned foreigners to settle in England; encouraged the arts and sciences, commerce and manufactures; formed a system of wise laws, and laid the foundation of many of those institutions which have contributed so much to the prosperity and greatness of Britain.

2. The mother of Henry II. is known as 'the Empress' Maud, because she married the Emperor Henry V., of Germany. Being left a widow, she married Geoffrey Plantagenet, and from this union sprung the royal line of Plantagenets.

3. Towards the close of the reign of Edward III., all the French conquests being lost, the shores of England insulted, and her fleets annihilated, the feudal baronage in their distress looked to the riches of the clergy, who held more than a third of the soil in landed property. Heavy taxes were imposed on Church lands, and a policy of confiscation was planned. The baronage, however, were powerless before the parliament of 1376, in which the knights of the shire united with the burgesses in a joint attack on the Royal Council. This parliament, through their speaker, La Mare, denounced the mismanagement of the war, the enormous taxation, and demanded an account of the expenditure. They received countenance and support from the Black Prince, but the death of the latter interrupted the work of reform. The greed of the triumphant barons, called to a new parliament by Lancaster, broke out in fresh strife with the Churchmen, who had, for some reason or other, supported the people. In the new plans of spoliation they were supported by John Wyclif, who saw in the anxiety of John of Gaunt and his followers to seize on the wealth of the prelates an opportunity to attempt the reform of the Church.

Notes on *A Manufacturing Town*.

DEFINITION.—A manufacturing town is one in which are situated works for manufacturing various materials, such as cotton, wool, flax, etc., into cloth of all kinds—names of these to be got from the children—calico, muslin, flannel, serge, linen, etc., specimens easily obtained.

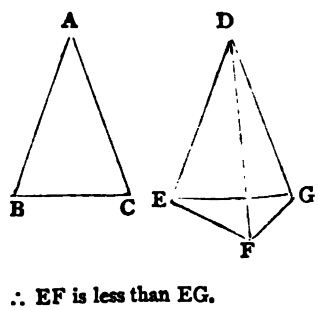
DESCRIPTION.—*Where situated.*—In localities where plenty of fuel can be got—where sea, river, or rail is convenient for bringing the raw material, and for carrying it off in the manufactured state. *Examples.*—Iron districts of England and Scotland always connected with coal give our country pre-eminence in working up iron. Cotton and woollen districts flourish near the same fields. Sea, a highway for bringing raw cotton to Lancashire. Yorkshire produces the wool which is there wrought up. Forfar receives its flax by sea from the shores of the Baltic. *Character.*—Compared with other towns they, having a greater population of the humbler classes, are neither so clean nor so well conducted (effect of the crowd on the streets at meal-hour); the immense traffic and general bustle of business—smoky and unhealthy atmosphere to be noted—advantage to be taken of asking information from children who have visited such towns.

EXAMPLES.—*Woollen.*—Leeds, as a centre, in England. Hawick, in Scotland. *Linen.*—Belfast, in Ireland, Dundee in Scotland. *Cotton.*—Manchester, in England. *Iron.*—Barrow-in-Furness, Middlesboro', in England. Glasgow, and surrounding towns, in Scotland, etc.

Euclid.

1. Prop. 7, Bk. 1.

2. Prop. 24, Bk. 1. Without the restriction in the construction there would be in all three cases to consider, two besides that in Euclid. The point F might fall *on* EG, or *above* EG, as well as *below* EG. If F falls *on* EG it is obvious that EF is less than EG, and if F falls *above* EG, the sum of DF and EF is less than the sum of DG and EG (I. 21),



and $\therefore$ EF is less than EG.

Music.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May, 1878*; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. What percentage of £20 is 7s. 6d.? and what percentage is $\frac{3}{10}$ of a gallon of $\frac{5}{12}$ of a barrel?

2. What should be the price per £100 of 3 per cent. stock in order that, after deducting an income tax of 4d. in the £, it may yield $3\frac{1}{2}$ per cent. interest to an investor?

3. A farmer having $37\frac{1}{2}$ score of sheep sold 8 per cent. of them to A., 90 of them to B., and $3\frac{1}{2}$ per cent. of the remainder to C. How many sheep had he left?

4. If 40 per cent. be gained by selling sugar at 1s. 3d. a lb., what per cent. will be gained by selling it at 5·0238095 guineas per cwt.?

5. What would be the difference in annual income from investing £3,450 in the 4 per cents. at 92, and in the $3\frac{1}{2}$ per cents. at 69?

FEMALES.

1. Divide ·8 by 476·3 and 36·34 by 674, each to four places of decimals, and prove the truth of each result.

2. Convert into decimals $2\frac{2}{3}$ of $8\frac{3}{4}-\frac{1}{2}$ of $1\frac{3}{4}$ of $\frac{7}{8}+\frac{1}{1}\frac{1}{3}$ of $7\frac{4}{11}$.

3. A corn dealer bought 198 bushels of barley for £32·5875, 100 bushels of which he sold for £·2375 a bushel. At what price per quarter may he sell the remainder so as to gain £2·1875 by his bargain?

Grammar.

1. 'And waiting to be treated like a wolf
Because I knew my crimes were known, I found
Instead of scornful pity, such a grace
Of tenderest courtesy, that I began
To glance behind me at my former life,
And find that it had been the wolf's indeed.'

TENNYSON.

(*a.*) Point out the noun sentences in the above and analyse them.

(*b.*) Point out any enlargement of the subject or extension of the predicate that you notice in the above.

(*c.*) Parse all the participles and verbs in the infinitive mood that occur in the above.

2. Of what Latin prepositions are the following words compounded:—Amputate, efface, circuit, collision, preface, succeed, suffuse, sojourn, tradition.

Geography.

1. Draw a full map of Hindostan.
2. Give full notes of a lesson on the River Nile.

SECOND PAPER.

One hour allowed for Females.
Two hours and a half allowed for Males.

History.

1. What efforts were made to disturb the throne of Henry VII.?

2. Who was Oliver Cromwell? Sketch his character and career.

3. The last European war in which England engaged was with Russia; mention the cause of the quarrel, the result of the war, and our allies.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Witherslack.*

Write, in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. The straight lines which join the extremities of two equal and parallel straight lines towards the same parts, are also themselves equal and parallel.

2. If a parallelogram and a triangle be upon the same base and between the some parallels; the parallelogram shall be double of the triangle.

O is any point within a parallelogram ABCD, and lines are drawn from it to the angles. Show that the triangles OAB, OCD are together equal to the triangle ABC.

Algebra.

1. Prove the rule for subtracting algebraical quantities.

Simplify $\{2x-(3y-z)\}-\{y+(2x-z)\}+\{3z-(x-2y)\}-\{2x-(y-z)\}$

2. Prove the rule for dividing an algebraical fraction by an integer.

Reduce to the simplest form:—

$$\frac{x^2-9x+20}{x^2-6x}\times\frac{x^2-13x+42}{x^2-5x}\div\frac{x-7}{x^2}$$

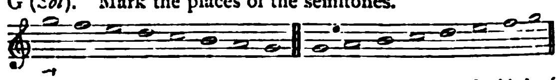
3. Solve the equations:—

$$1.\ \frac{2x}{3}-\frac{1-\frac{1}{2}x}{4x}=\frac{-1}{2}+\frac{x}{6}$$

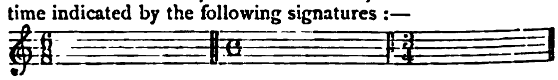
$$2.\ \frac{x-1}{x+3}-\frac{2x-1}{3x+1}=\frac{1}{3}.$$

Music.

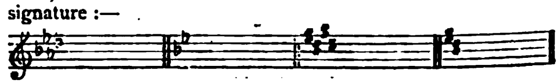
1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of G (*Sol*). Mark the places of the semitones.



2. Write a measure, of notes and rests, in each of the kinds of time indicated by the following signatures:—



3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature:—



ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. (*a*) 7s. 6d. $=\frac{3}{160}$ of £20, or $\frac{3\times100}{160}$ p. c. $=1\frac{7}{8}$.

(*b*) $\frac{3}{10}$ gall. $=\frac{\frac{3}{10}}{15}$ of $\frac{5}{12}$ of a barrel of 36 galls. or $\frac{3\times100}{150}$ p. c. $=2$.

2. £$3\frac{1}{2}$ is made by investing nominally £100.
£1 " " £$\frac{200}{7}$.
$\frac{236}{240}$ of £3 " " $\frac{236}{240}$ of £$\frac{600}{7}$

$\therefore$ £$\frac{600\times236}{240\times7}=$ £$\frac{590}{7}=$ £$84\frac{2}{7}$. Ans.

3. 8 p. c. of $37\frac{1}{2}$ score $=\frac{8}{100}$ of $750=60$ sold to A.; 90 more sold to B, leave $(750-150)=600$;

$3\frac{1}{2}$ p. c. of $600=\frac{600\times7}{200}=21$.

$\therefore$ the No. of sheep left $=600-21=579$ Ans.

4. 5·0238095 gui. = £5 5s. 6d. price of 1 cwt.
112 lbs. at $1\frac{1}{4}$s. = 140s. = £7 "
Prime cost = 140s. $\times\frac{100}{140}=$ 100s.
$\therefore$ to sell at $105\frac{1}{2}$s. gives a gain of $5\frac{1}{2}$ p. c.

5. Difference of income $= £3450 \times \left(\frac{3\frac{1}{3}}{69} - \frac{4}{92}\right)$

$= £3450 \times \frac{1\frac{1}{9} - 1}{23}$ or $\frac{1}{207}$

$= £\frac{3450}{207} = £\frac{150}{9} = \underline{£16\ 13^s.\ 4^d.}$ Ans.

FEMALES.

1. (*a*)

$476{\cdot}3\,)\,{\cdot}8000\,(\,\underline{{\cdot}0016\ldots\ldots}$

4763
32370
28578
37920

Proof by fractions—

$\cdot8 \div 476\cdot3$
$= \frac{8}{10} \div \frac{4763}{10}$
$= \frac{8}{4763} \times \frac{10}{10}$
$= \frac{8}{4763} \times \frac{10000}{10000}$
$= \frac{80000}{4763} \times \frac{1}{10000}$

Now $\frac{80000}{4763} = 16$......from above;

$\therefore$ the result $= \frac{16}{10000}$
$= \underline{\cdot0016}$. ....

(*b*)

$674)\,36{\cdot}34\,(\,\underline{{\cdot}0539}\ldots\ldots$

3370
2600
2022
6180
6066
114

Proof by fractions—

$36\cdot34 \div 674$
$= \frac{3634}{100} \div \frac{674}{1}$
$= \frac{3634}{674} \times \frac{1}{100}$
$= \frac{3634}{674} \times \frac{100}{10000}$
$= \frac{363400}{674} \times \frac{1}{10000}$

Now $\frac{363400}{674} = 539$......by the above.

$\therefore$ the result $= \frac{539}{10000} = \underline{\cdot0539}$......

2.

$2\frac{3}{5}$ of $8\frac{3}{4} = \frac{13 \times 35}{5 \times 4} = \frac{91}{4} =$ 22·75

Subtract $\frac{1}{2}$ of $1\frac{2}{3}$ of $\frac{7}{8} = \frac{1 \times 5 \times 7}{2 \times 3 \times 8} = -\frac{35}{48} = -$ ·72916

22·02083

Add $\frac{11}{12}$ of $7\frac{4}{11} = \frac{11 \times 81}{12 \times 11} = \frac{81}{12} =$ 6·75

28·77083

3.

Cost price of 198 bush. ...	... =	32·5875
Profit required	=	2·1875
Selling price of whole ...	... =	34·775
„ 100 bush.	... =	23·75
„ 98 bush. or $12\frac{1}{4}$ qrs.	=	11·025

$\therefore$ price per qr. $= £\frac{11\cdot025}{12\frac{1}{4}} = £\frac{44\cdot1}{49} = £\cdot9$ or $\underline{18s.}$ Ans.

Grammar.

1. (*a*) Noun sentences—(a_1) '(*that*) *my crimes were known.*'
(b_1) '*that it had been the wolf's* (*life*) *indeed.*'

Analysis of (a_1) (*that*)............connective.
my crimes ......subject and enlargement
were known......complete predicate.
„ (b_1) *that*...............connective.
it.....................subject.
had been ....incomplete predicate.
the wolf's (*life*) completion of predicate
indeed.........extension of predicate (*degree*).

(*b*) '*Waiting to be treated like a wolf*'—enlargement of subject '*I.*'
'*my*'—enlargement of subject '*crimes.*'
'*Instead of scornful pity*' is extension of predicate '*found.*'

(*c*) *Waiting*—incomplete part. of the reg. intrans. v. *to wait*, agreeing with *I.*
to be—pres. indef. infin. of *am, was, been*, forming with *treated*—complete part. of the reg. v. *to treat*, pres. indef. infin. passive voice.
known—complete part. of the trans. v. *know, knew, known*, forming with *were* past indef. indic. pass. voice.
to glance—pres. indef. infin. of the reg. v. *to glance*, gov. by *began*.
(*to*) *find* pres. „ „ „ irreg. v. *find, found, found*, gov. by began.
been—complete part. of *to be*, form. with *had* the past perf. indic. of the verb *to be*.

2. Amputate is compounded with the prep. *Ambi*—'about.'

efface	„	*ex*—'of, out of.'
circuit	„	*circum*—'about.'
collision	„	*con*—'together.'
preface	„	*pre*—'before.'
succeed	„	*sub*—'under.'
suffuse	„	id. id.
sojourn	„	id. id.
tradition	„	*trans*—'across.'

Geography.

Notes of a lesson on the *Nile*.

SOURCE.—In Lake Victoria Nyanza about 4000 ft. above sea-level. Lake discovered by Speke 1858, circumnavigated by Stanley 1875. Albert Nyanza another great reservoir of the Nile.

COURSE.—Main branch, Bahr el Abiad, or White Nile, flows in a N.W. direction for 800 miles; unites at Khartoum with the Bahr el Azrek; these form one large stream; enters the Mediterranean by a delta of two great arms, the two chief mouths being at Rosetta and Damietta.

TRIBUTARIES.—After leaving Victoria Nyanza, receives on W. Bahr el Ghazal, then from E. Giraffe and Sobat, the only other trib. besides the Bahr el Azrek is the Atbara or Tacazze from Abyssinia joining it on the right.

TOWNS ON ITS BASIN.—Damietta, Rosetta, Alexandria, Cairo, Beni-Souef, Siout, Kenneh, Thebes (ruins), Esneh, Assouan, Derr, Ipsambul, New Dongola, Berber, Meroë, Shendi, Khartum, *On B. el Azrek*, Khartum, Senaar, Gondar.

REMARKS AND CHARACTER.—One of the most celebrated rivers in the world; numerous attempts made to discover the source; river an object of veneration to the ancients; its valley very much confined in Nubia and Upper Egypt; most curious fact connected with the river is its annual *inundation*; this overflow makes Egypt a fertile country, which otherwise would be desert; inundation due to rains of Abyssinia and basin of Nyanza; river rises about thirty-one feet at Thebes and four at its mouths; overflow begins in Lower Egypt about midsummer; increases for three months; is stationary for twelve days; year after year same phenomenon recurs, almost always within a few hours of the same time, and within a few inches of the same height. It is a navigable stream from its junction with the Bahr el Azrek.

History.

1. In 1486, several risings of Yorkists, got up by the former partizans of Richard III., were easily suppressed. More formidable attempts, however, were to come in the shape of two impostures, strongly supported by Edward IV.'s sister, Margaret, Duchess Dowager of Burgundy. In 1487, a low-born impostor, named Lambert Simnel, was encouraged by the Yorkist faction to declare himself the young Earl of Warwick, whom Henry had imprisoned in the Tower. He was well received in Ireland, but, having landed in England with 2000 troops, was defeated at Stoke by the Royal troops. The Earl of Lincoln, who had actively supported Simnel, was slain in the battle, and the impostor became an assistant in the Royal scullery.

In 1492, a second and more troublesome impostor, named Perkin Warbeck, started up and kept his cause floating for five years before the public. This pretender gave out that he was the Richard, Duke of York, son of Edward IV., who was believed to have been murdered in the Tower. He also was well received in Ireland, was acknowledged by Margaret of Burgundy, and on visiting Scotland was kindly treated by James IV., who married him to a daughter of Lord Huntly. Being compelled to leave Scotland in 1497, he landed in Cornwall, and was soon at the head of a considerable force. On the approach of the Royal army, he meanly left his followers, surrendered, and was imprisoned in London. In 1498 he escaped, was recaptured, confessed his imposture, and was hanged.

2. Oliver Cromwell was the son of Robert Cromwell, and born at Huntingdon, 1599. He was returned as member for his native town to the third Parliament of Charles I., 1628. He was again elected in 1640. He was associated with Hampden,

Pym, and other popular leaders, and was one of the first to advocate resistance to the King's measures. In 1642 he received a captain's commission, and raised a troop of horse in his native county. So well were his soldiers disciplined, that after the battle of Marston Moor they got the name of Cromwell's Ironsides. At Naseby, Cromwell commanded the right wing, and Ireton, his son-in-law, the left. Charles was totally defeated in this battle, and ultimately gave himself up to the Scots at Newark. In 1649, when it was settled at his trial that the king should be executed, Cromwell is said to have reluctantly assented; but when convinced of the necessity of Charles's death, he seems to have had no hesitation in carrying the decision of the court into effect. After the execution, Cromwell became a principal member of the Council of State. He quelled a mutiny in the army, crossed over and conquered Ireland, returned to make war on Prince Charles and the Scots, whom he conquered at Dunbar and Worcester. In 1653 he expelled the Long Parliament, and was elected Protector of the Commonwealth, which office he held till his death in 1658.

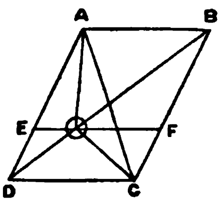
Cromwell has now come to be regarded as one of Eng'and's greatest rulers. He was a man of most marvellous genius, who after the age of forty became an invincible general and a wise statesman. He was a zealous patriot, and an enthusiast in religion. To him are we indebted for the great lesson of religious toleration.

3. The ambition of Russia was the immediate cause of the war. The Emperor Nicholas aiming at the possession of Constantinople, and making a pretext of quarrel out of Turkey's treatment of her Christian subjects in 1853, invaded Turkey. *England* and *France* united with *Turkey* in opposition to the designs of Russia, and towards the close of the war *Sardinia* joined the cause of the allies by sending 5000 men. After the destruction of Sebastopol, the war ended with the *Treaty of Paris*, signed on March 30th, 1856. By the terms of this peace the Russian Protectorate in the principalities of Moldavia and Wallachia was abolished, the freedom of the Danube and its mouths was established, and the Christian subjects of the Sultan were placed under the protection of England, France, Russia, Austria, and Sardinia.

Euclid.

1. Prop. 33, Bk. I.

2. Prop. 41, Bk. I. *Rider.* From any point O within the parallelogram ABCD, let OA, OB, OC, OD be drawn to the angles A, B, C, D; then the triangles AOB, DOC, shall be together equal to the triangle ABC, that is, to half the parallelogram, for the diagonal AC bisects it.



Through O draw EOF parallel to AB or DC. Then the figures ABFE, EFCD, are parallelograms. Because the triangle AOB, and the parallelogram ABFE are on the same base, AB, and between the same parallels, AOB is = half of ABFE. For the same reason DOC is = to half of EFCD. But ABFE, EFCD, make up the whole figure ABCD ∴ AOB, DOC are together = to half ABCD. That is to the triangle ABC.—Q.E.D.

Algebra.

1. Suppose we have to take $b+c$ from a. Then as each of the numbers b and c is to be taken from a the result is shown by $a-b-c$. That is $a-(b+c)=a-b-c$. Next, suppose we have to take $b-c$ from a. If we take b from a we obtain $a-b$; but we have taken too much from a, for we were required to take not b but $b-c$, that is b diminished by c. Hence we must increase the result by c; thus:—

$$a-(b-c)=a-b+c.$$

From the consideration of these cases we arrive at the following rule:—*Change the signs of all the terms in the expression to be subtracted and then add it to the other expression.*

$$\begin{array}{rcr}
\{2x-(3y-z)\} & = & 2x-3y+z \\
-\{y+(2x-z)\} & = & -2x-y+z \\
\{3z-(x-2y)\} & = & -x+2y+3z \\
-\{2x-(y-z)\} & = & \underline{-2x+y-z} \\
 & & \underline{\underline{-3x-y+4z}}
\end{array}$$

2. To divide a fraction by an integer we may either (1) *multiply the denominator*, or (2) *divide the numerator by it.*

(1) $\frac{a}{b} \div n = \frac{a}{bn}$; for in the fraction $\frac{a}{b}$ the unit is divided into b equal parts, a of which parts are taken; whereas in the fraction $\frac{a}{bn}$ the unit is divided into bn equal parts of which a parts are taken; now since each part of the latter fraction is $\frac{1}{n}$th of each part of the former, it follows that $\frac{a}{bn}$ is $\frac{1}{n}$ th part of $\frac{a}{b}$, hence $\frac{a}{b} \div n = \frac{a}{nb}$;

(2) $$\frac{bn}{a} \div n = \frac{bn}{an} = \frac{b}{a}.$$

The other form of the expression is

$$\frac{(x^2-9x+20)\,(x^2-13x+42)\,(x^2)}{(x^2-6x)\,(x^2-5x)\,(x-7)} = \text{(when broken up)}$$

$$\frac{(x-5)\,(x-4)\,(x-6)\,(x-7)\,x^2}{x^2\,(x-6)\,(x-5)\,(x-7)} = \underline{x-4).} \quad \text{Ans.}$$

3. (1) Clearing of fractions we obtain

$$\begin{aligned}
8x^2-3+\tfrac{3}{5}x &= 6x^2-6x+2x^2 \\
8x^2-6x^2-2x^2+\tfrac{3}{5}x+6x &= 3 \\
\tfrac{3}{5}x+6x &= 3 \\
15x &= 6 \\
x &= \underline{\tfrac{2}{5}}
\end{aligned}$$

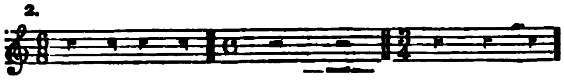
(2) Clearing of fractions we obtain

$$\begin{aligned}
9x^2-6x-3-6x^2-15x+9 &= 3x^2+10x+3 \\
9x^2-6x^2-3x^2-6x-15x-10x &= 3+3-9 \\
31x &= 3 \\
x &= \underline{\tfrac{3}{31}}. \quad \text{Ans.}
\end{aligned}$$

Music.

1.

2.



3.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May,* **1878; and Pupil Teachers at end of Fifth Year, if apprenticed before that date.**

Three hours and a half allowed.

Arithmetic.

MALES.

1. What interest (in £ s. d.) per cent. per annum is obtained from investing money in the 3 per cent. Consols at $91\frac{7}{8}$; brokerage $\frac{1}{8}$ per cent.?

2. If iron, sold at the rate of £4·9875 per ton, yields a profit of 17 per cent., what must have been the expense (in £ s. d.) per ton of raising it?

3. A plumber sold 288 cwt. of lead for $311\frac{11}{14}$ guineas, and gained thereby at the rate of $12\frac{1}{2}$ per cent. What did the lead cost him *per ton?*

4. What must be the price of £100 stock in the $3\frac{1}{2}$ per cents., if an annual income of £3166 13s. 4d. can be secured by investing £80,071 8s. 6·857142d. in them?

5. Two persons, A and B, together rent a field of $27\frac{1}{2}$ acres for £38. One puts 30 sheep in for six weeks, and the other 20 sheep for 10 weeks. They agree to pay the rent and receive the profits according to the amount of feed taken by each, and they clear £57 by the sale of the hay. What are the rents, and profits, of A and B respectively?

FEMALES.

1. If 16·125 yards of calico, 1·375 yards wide, cost £2·2, what ought 45 yards ·875 yards wide, at the same price per yard to cost?

2. A man embarks his capital in four successive ventures. In the first he clears £100 per cent., and in each of the others he loses 20 per cent., show that there remains to him a profit 2·4 per cent. on his original outlay.

3. If $(2\frac{1}{2}\ \frac{3}{5}) \div (\frac{5}{8}$ of $3\frac{1}{5})$ of an acre of land be worth 35 guineas, what will 7 times $\left(\dfrac{7\frac{3}{5} - 4\frac{1}{4}}{\frac{1}{2} \text{ of } 3\frac{4}{5}} \times \dfrac{7\frac{3}{5}}{31\frac{3}{5}}\right)$ of $2\frac{1}{2}$ acres be worth at the same rate?

4. £150 placed at a savings bank amounts in four years to £165; what is the rate per cent. per annum simple interest?

Grammar.

1. 'As for jest, there be certain things which ought to be privileged from it, namely, religion, matters of state, and any case that deserveth pity; yet there be some that think their wits have been asleep, except they dart out somewhat that is piquant, and to the quick; that is a vein that should be bridled.'

BACON.

(*a*) Analyse the above passage as far as 'deserveth pity.'
(*b*) Comment on the different uses of the word 'that' in the above.
(*c*) Give the meaning of the above passage in your own words.

2. Parse each word in the following:—
I knew one was wont to say in scorn: 'He must needs be a wise man, he speaks so much of himself.'

3. The ancient English is described as having been an 'inflexional' language to a much greater extent than the English we now use. Explain this statement, and mention any points you can think of in illustration of it.

Geography.

1. Give full notes of a lesson on the River Nile, and draw a map to illustrate the lesson.
2. What are '*currents*' in the ocean? Mention the chief currents that you know, and describe them minutely.

SECOND PAPER.

One hour allowed for Females.
Two hours and a half allowed for Males.

History.

1. When was our parliament divided into two houses? The parliament of 1376 has been called 'the good parliament'; why?
2. Who was the first crowned queen to suffer death on the scaffold in England? Narrate the circumstances.
3. Show how the throne passed from the Plantagenets to the Tudors, and from the Tudors to the Stuarts.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Witherslack.*

Write, in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

Composition.

Write a short essay on *Heat, and its uses.*

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. If a straight line be divided into any two parts, the rectangle contained by the whole and one of the parts, is equal to the rectangle contained by the two parts, together with the square on the aforesaid part.

What is the corresponding result in algebra?

2. In obtuse-angled triangles, if a perpendicular be drawn from either of the acute angles to the opposite side produced, the square on the side subtending the obtuse angle, is greater than the squares on the sides containing the obtuse angle, by twice the rectangle contained by the side upon which, when produced, the perpendicular falls, and the straight line intercepted without the triangle between the perpendicular and the obtuse angle.

3. The diagonals of a parallelogram are equal: find its angles.

Algebra.

1. Prove the rule for finding the G.C.M. of two algebraical expressions.
2. Solve the equations:

$$(1)\quad \left.\begin{aligned} 2(x+y) &= 3(x-y) + 10 \\ 2x - y &= 4(2y - x) + 3 \end{aligned}\right\}$$

$$(2)\quad \frac{x+2}{x-1} - \frac{4-x}{2x} = 2\frac{1}{2}.$$

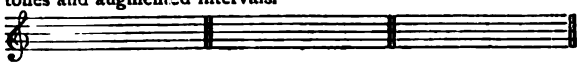
3. A number composed of two digits is equal to seven times its unit's figure; and if the digits be reversed, its value is increased by 18. Find it.

Mensuration.

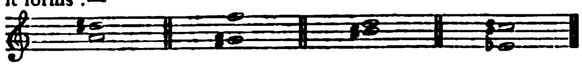
1. Find the area of an equilateral triangle whose side is 25 ft.
2. A circle of radius 10.15 ft. falls entirely within another circle of radius 13.35 ft.; find the area between the circles.

Music.

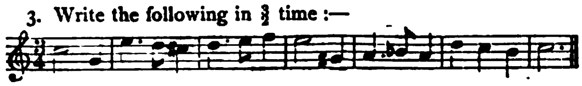
1. Write the upper tetrachord of G (*Sol*) minor, in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.



2. Write, under each of the following pairs of notes, the name and quality (major, perfect, diminished, or other) of the interval it forms:—



3. Write the following in $\frac{3}{2}$ time:—



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. $£91\frac{3}{4}+\frac{1}{8}$ or $£91\frac{7}{8}$ brings £3 of interest.

$£1$,, $£\frac{24}{735}$

$\therefore £100$,, $£\frac{24 \times 100}{735}$

i.e., $£\frac{160}{49} = \underline{£3\ 5s.\ 3\frac{33}{49}d.}$ Ans.

2. What was sold for £117 cost £100

$\therefore$,, ,, $£4{\cdot}9875$,, $£100 \times \frac{4{\cdot}9875}{117}$

i.e., $\frac{£498\ 15s.}{117}$

i.e., $\underline{£4\ 5s.\ 3\frac{1}{13}d.}$ Ans.

3. $31{\cdot}1{\cdot}1\frac{1}{4}$ gui. $\div 14\frac{3}{8} = £\frac{4365 \times 5 \times 21}{14 \times 72 \times 20}$ = price of a ton.

Now what was sold for $£112\frac{1}{2}$ cost £100

and ,, ,, $£1$,, $£\frac{100}{112\frac{1}{2}}$

$\therefore$,, $£\frac{4365 \times 5 \times 21}{14 \times 72 \times 20}$,, $£\frac{200}{225} \times \frac{4365 \times 5 \times 21}{14 \times 72 \times 20}$

i.e., $£\frac{485}{24}$

i.e., $\underline{£20\ 4s.\ 2d.}$ Ans.

4. (*a*) $£3\frac{1}{3}$ is got from £100 of stock

$£1$,, $£\frac{300}{10}$,,

$£3166\frac{2}{3}$,, $£\frac{300}{10} \times \frac{9500}{3}$,,

i.e., £95000 ,,

(*b*) And £95000 of stock is purchased for $£80071\ 8s.\ 6\frac{6}{7}d.$

,, ,, ,, $£\frac{560500}{7}$

$\therefore £100$,, ,, $£\frac{560500}{7} \times \frac{100}{95000}$

i.e., $£\frac{590}{7} = \underline{£84\frac{2}{7}.}$ Ans.

5. 30 sheep for 6 weeks = 180 for 1 week

20 ,, 10 ,, = 200 ,,

Total = 380 ,,

$\therefore$ A's rent $= \frac{180}{380}$ of £38 $= \underline{£18}$; and $\therefore$ B's $= \underline{£20.}$

And A's profit $= \frac{180}{380}$ of £57 $= \underline{£27}$; and $\therefore$ B's $= \underline{£30.}$

FEMALES.

1. $\left.\begin{matrix} 16{\cdot}125 \text{ yds.} : 45 \text{ yds.} \\ 1{\cdot}375\ \text{,,} : {\cdot}875\ \text{,,} \end{matrix}\right\} :: £2{\cdot}2$: money required.

$$£2{\cdot}2 \times \frac{45}{16{\cdot}125} \times \frac{{\cdot}875}{1{\cdot}375} = £\frac{11}{5} \times \frac{360}{129} \times \frac{7}{11}$$

$= £\frac{168}{43}$

i.e. $\underline{£3\ 18s.\ 1\frac{29}{43}d.}$ Ans.

2. Suppose he lays out at the beginning £100,

Then (1) He lays out £100 and gains $\frac{100}{100}$ of it, giving £200 of cap.
,, (2) ,, 200 ,, loses $\frac{20}{100}$,, leaving 160 ,,
,, (3) ,, 160 ,, ,, $\frac{20}{100}$,, ,, 128 ,,
,, (4) ,, 128 ,, ,, $\frac{20}{100}$,, ,, 102·4 ,,

But he laid out £100 at the beginning ∴ he is left with a profit £2·4 on his original outlay, and £2·4 gained on £100 must be 2·4 p.c.

3. $(2\frac{1}{2}\text{ of }\frac{3}{5})\div(\frac{5}{8}\text{ of }3\frac{1}{5})$ of 1 ac. $=\frac{5\times 3}{2\times 5}\times\frac{8\times 5}{5\times 16}$ or $\frac{3}{4}$ ac.

$$7\times\left(\frac{7\frac{8}{15}-4\frac{3}{15}}{\frac{1}{3}\text{ of }\frac{23}{6}}\times\frac{\frac{23}{5}}{\frac{281}{9}}\right)\text{ of }\frac{3}{4}\text{ ac.}=\frac{7}{1}\times\frac{10}{3}\times\frac{18}{23}\times\frac{23}{5}\times\frac{9}{281}\text{ of }\frac{3}{4}\text{ ac.}=7\frac{1}{2}\text{ ac.}$$

The question now stands thus—

$\frac{3}{4}$ ac. are worth £36 15s.
∴ $7\frac{1}{2}$,, ,, £36 15s. $\times\frac{15}{2}\times\frac{4}{3}$
i.e., £367 10s. Ans.

4. (£165 − £150) = £15 interest of £150 for 4 yrs.
= £$3\frac{3}{4}$,, ,, 1 yr.
∴ Interest of £100 for 1 yr. = £$3\frac{3}{4}\times\frac{100}{150}$
$=£\frac{15\times 100}{4\times 150}$
i.e. £$2\frac{1}{2}$ p.c.

Grammar.

1. (a).

Sentences and Clauses.	Kind of S. or C.	Connective.	Full Subject.	Predicate.	Completion of Pred.	Extensions of Pred.
1.—As [*the matter stands*] (?) for jest.	A kind of parenthetical, giving emphasis to *it* in (3).	As	[the matter] (?)	[stands] (?)	for jest	
2.—There be certain things, namely, religion, matters of state, and any case.	Principal.		Certain things, namely, religion . . . . case.	be		*there* is merely an introductory word
3.—Which ought to be privileged from it.	Adjectival to *things* in (2).		which	ought	to be privileged from it.	
4.—That deserveth pity.	Adject. to *case* in (2).		that	deserveth	pity (object).	

(b) '*That*' in the given sentence is used both as a relative and a demonstrative pronoun. As a relative it is capable of being changed into 'which,' as 'a vein which should be bridled,' as a demonstrative pronoun it is used substantively, as 'that is a vein.'

(c) Men's religious and political beliefs, as well as all forms of human misery, ought not to be considered proper subjects upon which to make jests. Some people, however, have a tendency to make sharp and cutting jokes that hurt men's feelings. Such an inclination should be carefully kept in check.

2. *I*—pers. pron. 1st pers., mas. or fem., sing. nom. subj. of *knew*.
knew—trans. verb, irreg. *know*, *knew*, *known* indic., past indef., 1st pers. sing. agreeing with *I*.
one—indef. pron., third pers. mas., sing. obj. gov. by *knew*.
was—intrans. verb. irreg. *am*, *was*, *been*, indic. past indef. 3rd pers. agrees with subj. (*who*).
wont—complete part. from O.E. *wunian* to dwell; used only predicatively as an adjective referring to *he* in this sentence.
to say—trans. verb, irreg. *say*, *said*, *said*, infin. pres. indef. gov. by *wont*.
in—prep. gov. obj. case *scorn*. } *in scorn* =
scorn—abstr. noun, neut. sing. obj. gov. by *in*. } scornfully.
he—demonstr. pers. pron. 3rd pers. sing. mas. nom. subj. of must.
must—defec. v. used only in pres. indic., forming with pres. infin.
be—3rd pers. sing., pres. pot. of the verb *to be*, agreeing with *he*.
needs—adv. (=of necessity) from an old genitive in *es* modif. *must be*.
a—indef. article generally reckoned an adj. joined to *man*.
wise—qual. adj. pos. deg. limiting *man*.
man—com. noun, mas. sing. nom. in apposition with *he*.
he—pers. pron. 3rd pers. mas., sing. referring to *man*, nom., subj. of *speaks*.
speaks—intrans. verb, irreg. *speak*, *spoke*, (*spake*), *spoken*, indic. pres. indef., 3rd pers. sing. agrees with subj. *he*.
so—adv. of degree mod. *much*.
much—adv. ,, ,, *speaks*.
of—prep. gov. obj. case himself.
himself—reflective pers. pron., 3rd pers. mas. sing. obj. gov. by *of*.

3. Old English differed from modern English in this respect, that it had a greater number of grammatical inflexions, that is, it made more changes in the words themselves to express changes of meaning. Thus nouns had five cases and different declensions; adjectives were declined, and had three genders; pronouns had more forms, and verbs had a greater variety of personal terminations. Modern English has dropped the greater part of these inflexions, and in their place are used prepositions and auxiliary verbs. The above explains what is meant when people say that ancient English was a more 'inflexional' language than modern English.

Geography.

1. *See same question answered under Third Year in this number of the Magazine.*

2. Immense rivers of heated waters flowing through the comparatively cool and motionless waters of the ocean are met with by seamen; while sometimes the moving stream has a much lower temperature than the rest of the sea. These are called *ocean currents*, and exist in all the great oceans.

The chief are the *equatorial currents*, flowing round the globe wherever the land allows. In the Atlantic, one of these great streams starts from St. Thomas, on the coast of Africa, and runs westward towards the shoulder of S. America. Before arriving there it throws off a branch to the south, which goes down the coast of Brazil to the lower extremity of S. America, and there turns eastward to the Cape of Good Hope. The main stream sweeps past the north coast of S. America with such strength that not even the mighty current of the Amazon can turn it aside, passes through the Windward Islands, across the Caribbean Sea, and into the Gulf of Mexico. As the current sweeps round the Gulf it becomes very hot, and is swollen by the waters of the Mississippi, till at length, under the name of the *Gulf Stream*, it forces its way into the Atlantic, between Florida and Cuba, in a stream of from thirty to forty miles wide. Its heat is from 75° to 85° Fahr. when it leaves the Gulf. At first it keeps pretty close to the coast of America, but by degrees it widens out and bears away to the east, running between Newfoundland and the Azores. Dividing there, the main body turns round the Azores, and goes off southwards to Africa. The other portion runs on northward between Great Britain and Iceland, giving warmth and moisture to Cornwall, Ireland, the Hebrides, and the Shetland Islands. This famous current has been known to carry the weeds and seeds of other lands to the coast of Norway, and even Spitzbergen. Now the northward motion of the Gulf Stream necessitates a southward motion from the Polar seas. Beneath the Gulf Stream and on the inner or land side flows a current of cold water from past Labrador to replace the warm water brought up from the tropics.

In the Pacific Ocean there is also a great equatorial current, which starts from the Bay of Panama and runs right across the ocean, past the Caroline and Ladrone islands, to the Philippines. There it is met by a current which issues from the Chinese Sea, much the same as the Gulf Stream does from the Mexican Gulf, and the two then run outside of Japan and round the north limits of the Pacific, and so down to California.

In the Indian Ocean the main current starts from the Bay of Bengal, sweeps past Ceylon and the Seychelles islands, and between Africa and Madagascar, to the Cape of Good Hope, where it is suddenly checked and turned back to the S.W.

History.

1. Our Parliament was divided into two houses probably in the reign of Edward III.

The Parliament of 1376 was called '*the Good*,' because, supported by the Black Prince, it boldly set itself to work a reformation of the evils wrought by the the men selected for the Government by the Duke of Lancaster. The Commons, among whom the *Knights of the Shire* took the chief part, impeached the Duke's friends before the Lords, charging them with frauds upon the King, and with extortion of money, and obtained their imprisonment or removal. Alice Perrers was expelled from the court on account of the evil domination which she held over Edward III.

2. *Anne Boleyn* was the first crowned queen to suffer death on the scaffold in England. The King, Henry VIII., being smitten with the charms of Jane Seymour, found a way of ridding himself of Anne by a charge of adultery. Whether the charge was true or not the marriage was declared null and void, and she was beheaded, leaving one daughter, *Elizabeth*.

3. (*a*) Henry Tudor, grandson of Catharine, widow of Henry V., and Owen Tudor, having defeated and slain the usurper, Richard III., who was the last Plantagenet king, succeeded to the throne in 1485 as Henry VII. (*b*) Queen Elizabeth having died without heirs (1603) was succeeded by James VI. of Scotland, who was the next heir in the direct line, being descended from Henry VII. through his mother, Mary Stuart, the daughter of James V., who was the son of James IV. and Margaret Tudor.

Composition.

Heat and its Uses.

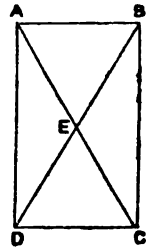
Whether heat be a substance penetrating and infusing itself along all bodies, or only a quality of these bodies, to its influence are we indebted for the proper performance of all the functions of life, for all that our eyes see and that our ears delight in, as well as for everything that gratifies the taste. We not only depend on the heat itself, but we require to have it in due proportions, because either too much or too little of it is alike injurious, and even fatal, to both animal and vegetable life.

To distinguish the sensation of heat from heat itself, and prevent the confusion arising from interchange of terms meaning sometimes one thing and sometimes another, the term *caloric* has been employed to denote that which causes the production of heat. We often hear the terms *heat* and *cold* used in every-day life, the latter being employed to mean an agent directly opposed to the former, but, strictly speaking, cold is only the absence of heat. We all know by experience that the gradual loss of heat gives us the feeling of cold, but this is only a relative term, since there is no body entirely destitute of heat, though there may be less heat in one substance than another. Seeing that our sensation of heat is very defective as a heat measurer, an instrument called a *thermometer* is used to detect the quantity of heat in any substance. By means of this instrument we are able to compare bodies as to the quantity of heat in each, the one having more heat being said to have a higher *temperature* than that which has less. Heat is imparted from one body to another in two ways, by *radiation* and by *conduction*. If we place ourselves before a fire we feel the heat darting towards us in rays, as it were—this is an example of *radiation*; and if we place a bar of iron in the fire we can feel the part projecting gradually getting warmer, although not in actual contact with the coals, the heat in this instance being led or conducted along the particles of the metal, and this gives us an illustration of *conduction*. From the fact that some materials are good conductors, and some *bad*, or *non*-conductors, attention to this gives us a guide in the selection of clothing and building materials to suit different climates.

Euclid.

1. Prop. 3, Bk. II. This proposition may be represented algebraically thus:—Let the whole line contain a linear units—one part contain m and the other n linear units. Then $a=m+n$. Multiply these units by m $\therefore$ $ma=m^2+mn$. That is, if a number be divided into two parts, the product of the whole number and one of the parts is equal to the square of that part, together with the product of the two parts.

2. Prop. 12, Bk. II.



Let ABCD be a parallelogram, whose diagonals AC, BD are equal, then its angles shall be right angles. Because the diagonals of a parallelogram bisect each other, then AC, BD are bisected in E. Then, because EB=EC, the angle EBC=angle ECB (i. 5). For the same reason the angles ECD, EDC are equal. Therefore the whole angle BCD is equal to the two angles CBD, BDC—that is, BCD is=to the half of two right angles. It is therefore a right angle, and BC is parallel to AD, and the two interior angles, ADC, DCB are equal to two right angles; but DCB was shown to be a right angle, therefore ADC is a right angle. And since the opposite angles of a parallelogram are equal to one another, then each of the angles of the figure ABCD is a right angle.—Q. E. D.

Algebra.

1. The proof of the rule for finding the G. C. M. depends on the following principles:—

(*a*) If D divide A, then it will divide mA. For since D divides A, we may suppose A$=a$D, then mA $=ma$D; thus D divides mA.

(*b*) If D divide A and B it will divide $m\mathrm{A}\pm n\mathrm{B}$. For since D divides A and B, we may suppose A$=a$D, and B $=b$D, then $m\mathrm{A}\pm n\mathrm{B}=(m\mathrm{A}\pm n\mathrm{B})$ D; thus D divides $m\mathrm{A}\pm n\mathrm{B}$.

Let A and B denote the two algebraical expressions, and let them be arranged according to descending powers of some common letter, and suppose the index of the highest power of that letter in A not less than the index of the same letter in B. Divide A by B; let p denote the quotient, and C the remainder. Divide B by C; let q denote the quotient and D the remainder. Divide C by D, and suppose that there is no remainder, and let r denote the quotient. Thus we have the following results:—

B) A (p
pB
C) B (q
qC
D) C (r
rD

$$\mathrm{A}=p\mathrm{B}+\mathrm{C};\ \mathrm{B}=q\mathrm{C}+\mathrm{D};\ \mathrm{C}=r\mathrm{D}.$$

Now, D divides C since C$=r$D; hence by principle (*a*) D also divides qC, and also qC+D; that is, D divides B. Again, since D divides B and C, it divides pB+C; that is, D divides A. Hence, since D divides A and B, it is a common measure of them. D is not only *a* common measure, but *the* greatest common measure.

By principle (*b*) given above, every expression which divides A and B divides A$-p$B, that is, C; thus every expression which is a measure of A and B is a measure of B and C. Similarly every expression which is a measure of B and C is a measure of C and D. Thus every expression which is a measure of A and B divides D. But no expression higher than D can divide D. Thus D is the G. C. M.

2. (1) (*a*)

$$2(x+y)=3(x-y)+10$$
$$2x+2y=3x-3y+10$$
$$-x+5y=10$$
$$-2x+10y=20$$

(*b*)

$$2x-y=4(2y-x)+3$$
$$2x-y=8y-4x+3$$
$$6x-9y=3$$
$$2x-3y=1$$

From (*a*) $-2x+10y=20$

By adding ... $7y=21$

$$y=\underline{3}$$

By substitution $-x+15=10$ or $-x=10-15$ $\therefore x=\underline{5}$

(2)

$$\frac{x+2}{x-1}-\frac{4-x}{2x}=\frac{7}{3}.$$

Clearing of fractions—

$$6x^2+12x-15x+3x^2+12=14x^2-14x$$

Collecting ... $5x^2-11x=12$

Dividing by 5 $x^2-\frac{11}{5}x=\frac{12}{5}$

Completing the square $x^2-\frac{11}{5}x+\frac{121}{100}=\frac{240+121}{100}=\frac{361}{100}$.

Taking the root, $x-\frac{11}{10}=\pm\frac{19}{10}$

$$x=\frac{11}{10}\pm\frac{19}{10}=\underline{3}\text{ or }-\underline{1\tfrac{1}{2}}\text{ Ans.}$$

3. Let x = the unit's, and y = the ten's figure.

(1) then the no. $=10y+x=7x$.

(2) But if $10x+y$ be the order of the digits, then $10x+y=7x+18$ from (1) $10y=6x$.

$y = \frac{3}{5}x \therefore$ substituting $\frac{3}{5}x$ for y in (2)

$$10x + \tfrac{3}{5}x = 7x + 18$$
$$50x + 3x = 35x + 90$$
$$18x = 90$$
$$x = 5$$

Hence the no. $= 7 \times 5 = \underline{35}$. Ans.

Mensuration.

1. Area of equilateral triangle $= 25^2 \times {\cdot}433$ (which is the approximate area of an equilateral triangle, whose side is 1.) $= 625 \times {\cdot}433$

```
     ·433
     1875
    1875
   2500
  270·625 sq. ft. Ans.
```

2. Diameter of outer circle = 26·7 ft.
 „ inner „ = 20·3 „

And the required area = sum of diars. × by their diff. × ·7854
$= 47 \times 6{\cdot}4 \times {\cdot}7854$

```
       6·4
      188
     282
     300 8
     ·785 4
    1 203 2
   15 040
  24 064
 210 56
 236·2 483 2 sq. ft. Ans.
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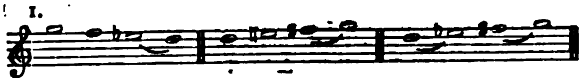
Music.

1.



2.

Pluperfect 4th. Diminished 7th. Diminished 3rd. Augmented 6th.

3.

—o—

☞ As it is probable that 'Proportion' will henceforth have to be worked by the 'Unitary Method,' we have pleasure in acceding to the request of several correspondents to give a short description of that method.

The Unitary Method in Proportion.

BY W. P. WORKMAN, TRINITY COLLEGE, CAMBRIDGE.

IT is our purpose in the following paper to give an account of one of the greatest simplifications which has been effected in modern arithmetic. All of us have, at some time or other, been subjected to the domination of that imperious and arbitrary Rule of Three, and there can be but few who will not be glad to escape from it. Of the advantages of a new method we shall leave the numerous appended examples to silently testify, only stating that the introduction of this method is in accordance with the important canon by which alone every mathematical improvement must be tested before it can be accepted. That is—while not attempting to elucidate any new facts, it clears up old ones, and at the same time does not increase the number of things to be remembered, or the number of principles to be applied.

It is almost impossible to formulate the Unitary System in words, for when we attempt to do so we arrive at nothing but self-evident axioms. It amounts to the following rule:—

Given the unit we may find the value of any number of units by multiplication, or the number of units amounting to any given value, by division. Thus if one copy of a book weigh 6 ounces, a thousand copies will weigh 6,000 ounces. It is perhaps possible that the uninitiated will affirm that the rule as it stands is not more intelligible than the mysterious rows of dots in the Rule of Three, while the example is, and always has been, a truism. Let us, then, first put the example in algebra—

If a things cost £x
ab „ £bx.

Now we may proceed to point out that this simple process is really all that is necessary for working out examples in Simple or Double Proportion. For instance:—

If $\frac{7}{8}$ of a vessel cost £770, what is the value of $\frac{3}{4}$ of it?

The old method was to write down the result thus:

$$\tfrac{7}{8} : \tfrac{3}{4} :: 770 : \text{value in pounds.}$$

$$\therefore \text{value} = £\frac{\frac{3}{4} \times 770}{\frac{7}{8}} \text{ or } £660.$$

Undoubtedly this is short enough, but not one scholar in ten understands it when he applies it. Now observe the rational common-sense Method of Unity.

$\frac{7}{8}$ cost £770.
$\therefore \frac{1}{8}$ „ £110.
$\therefore 1$ „ £880.
$\therefore \frac{1}{4}$ „ £220.
$\therefore \frac{3}{4}$ „ £660.

At first sight this seems longer; but remembering that of the four steps not more than two at the utmost would be necessary—for the first two and last two could be compressed into one each—remembering also that every one of the four steps is logical and straightforward, and that an accomplished worker can easily write down the answer—in a complex form, of course—to any sum, however involved, in Simple *or* Compound Proportion, the objections would vanish.

Double Rule of Three, or, as we have called it, Compound Proportion, is the one bugbear in arithmetic which children uniformly detest. If taught to look at it from our standpoint, we believe that all their objections to it will ultimately vanish. We will give an example in both methods.

Ex. If 27 yds. of cloth, $\frac{3}{4}$ yds. wide, cost £20, what must be given for 36 yds. of cloth $\frac{1}{2}$ yd. wide?

Old Method.—If the 36 yds. were of same width as 27 yds., cost would be found from equation.

$$27 : 36 :: £20 : \text{cost}$$

or cost $= £26\frac{2}{3}$. Thus our question reduces itself to

If 36 yards, $\frac{3}{4}$ yd. wide, cost £$26\frac{2}{3}$, what will same number of yards cost when cloth is $\frac{1}{2}$ yd. wide?

This we find thus:

$$\tfrac{3}{4} \text{ yard} : \tfrac{1}{2} \text{ yard} :: £26\tfrac{2}{3} : \text{cost}$$
$$\therefore \text{cost} = £17\ 15s.\ 6\tfrac{2}{3}d.$$

New Method.—In this particular example we should first rewrite it thus:—

If cloth of the area of $27 \times \frac{3}{4}$ sq. yds. cost £20, what will be given for an area of $36 \times \frac{1}{2}$ yds?

Now $27 \times \frac{3}{4}$ cost £20

$$\therefore \ 1 \text{ costs } £\frac{20 \times 4}{81}$$

$$\therefore 36 \times \tfrac{1}{2} \text{ cost } \pounds\frac{20 \times 4 \times \cancel{18}^{\,2}}{\cancel{81}_{\,9}}$$

$$\text{or } \pounds\frac{160}{9}$$

The only rule which can fairly be called a rule at all, is one rather of expediency than necessity. It is advisable to keep the unknown quantity until *the end of the original statement* of the problem. An example will illustrate our meaning :—

If 200 *men can in* 25 *days make an embankment* 5 *miles long, how much overtime must* 60 *men work in order to finish an embankment* 2 *miles long in* 32 *days,* 12 *hours being a day's work ?*

Here the unknown quantity is time, and we state the date as follows, putting time last—

200 men do 5 miles in 25 days.
1 man does " 25 × 200 days.
1 man does 1 mile in 1000 days.
60 men do 1 mile in $\frac{100}{6}$ days.
60 men do 2 miles in $\frac{100}{3}$ days.

But we are told that they do it in 32 days

$\therefore$ Their days must be $\frac{100}{3 \times 32}$ of the first men's days

i.e.—They are $\frac{100}{3 \times 32} \times 12$ hours
or $12\frac{1}{2}$ hours

$\therefore$ They must work $\frac{1}{2}$ hour overtime.

As another example take :—

Assume that 6 *men can do as much work in an hour as seven women, and* 8 *women as much as* 11 *boys, and that* 5 *men can do a certain piece of work in* 10 *hours. How long will it take* 1 *man,* 2 *women, and* 3 *boys together, to do the same piece of work ?*

5 men do work in 10 hours.
1 man does work in 50 hours (a common mistake is to write 2 hours here.)
$\therefore$ 1 man does $\frac{1}{50}$ of work in an hour.
7 women do as much as 6 men.
$\therefore$ 1 woman does $\frac{6}{7}$ as much as a man.
$\therefore$ 1 woman does $\frac{3}{175}$ of work in an hour.
11 boys do as much as 8 women.
$\therefore$ 1 boy does as much as $\frac{8}{11}$ women.
$\therefore$ 1 boy does $\frac{8}{11} \times \frac{3}{175}$ of work in an hour.
$\therefore$ when 1 man, 2 women, and 3 boys are at work, their combined efforts accomplish

$$\left\{ \frac{1}{50} + 2 \times \frac{3}{175} + 3 \times \frac{8}{11} \times \frac{3}{175} \right\} \text{ of work in an hour.}$$

i.e.—$\frac{353}{3850}$.

Hence they will do the whole work in $\frac{3850}{353}$ hours, or $10\frac{320}{353}$ hours.

It is unnecessary to add further example. The method is of use where ordinary Rule of Three is either cumbrous or unmeaning, and is capable of being applied to all the cases to which the original rule was applicable. It will therefore be useful in stocks, interest, etc., etc.

In conclusion, we advise every one to whom the method is new to take his arithmetic and work out a hundred examples by it. As an additional help he will find examples illustrative of the method, worked out on the following pages of the PRACTICAL TEACHER :— 207, 254 (2 examples), 308, 309, 310, 345, 406, and 461.

Scholarship Examination, 1881.

FEMALE CANDIDATES.

Arithmetic.

Three hours allowed for this paper.

Candidates are not permitted to answer more than *one* Question in each Section.

The *solution* must in every instance be given at such length as to be intelligible to the Examiner, otherwise the answer will be considered of no value.

SECTION I.

1. The circumference of the earth is, in round numbers, 25,000 miles ; how many feet does it contain ?

2. Add together 4 tons 17 cwt. 3 qrs. 18 lbs. ; 2 tons 3 cwt. 3 qrs. 15 lbs. ; 13 tons 9 cwt. 2 qrs. 25 lbs. ; and 22 tons 18 cwt. 3 qrs. 19 lbs. ; and divide the result by 133.

SECTION II.

1. Find the value of 733¼ articles at £2 18s. 6d. each ; and of 751½ at £1 8s. 11d. each ; and subtract the less from the greater.

2. If sugar be bought at £1 19s. 6d. per cwt., and retailed at 6½d. per lb., what is the profit on a cask containing 7 cwt. 1 qr. 14 lbs. ?

SECTION III.

1. A householder paid the following bill with a five-pound note : what change did he receive ?—

3½ cwt. of coals at 10½d. per cwt.
13 lbs. of cheese at 7¾d. per lb.
2¾ lbs. of tea at 3s. 3d. per lb.
17 lbs. of sugar at 5¼d. per lb.
8½ yards of flannel at 1s. 11½d. per yard.
29 yards of calico at 10¾d. per yard.

2. A lady paid with 3 ten-pound notes for—

64 yards of sheeting at 14½d. per yard.
4 pairs of blankets at 18s. 4d. per pair.
3 pairs of blankets at 12s. per pair.
18½ yards of silk at 5s. 6d. per yard.
26 yards of buckaback at 10¾d. per yard.
9 damask table cloths, 4 of them at 19s. 6d. each, and the remainder at £1 6s. 6d. each.
4 balls of string at 1s. 6d. for a dozen balls.

What change should she have received, the tradesman allowing a guinea and a half discount on the whole for cash ?

SECTION IV.

1. Find, by Practice, the value of 3 qrs. 5 lbs. 9 ozs. at £2 14s. 6d. per lb.

2. Find, by Practice, the amount of a rate of 13s. 4½d. in the £ on £1,710 16s. 8d.

SECTION V.

1. If the poor-rate on a house rated at 60 gs. be £2 8s. 6¾d., what amount of poor-rate ought to be paid on a farm rated at £1,904 ?

2. A farmer sold five lots of rye, each containing 34 bushels 2½ pecks, for £40 7s. 11d. How much ought 100 quarters of the same rye to fetch at that rate ?

SECTION VI.

1. If 24 lbs. of wool make 115 yards of cloth 1 yard wide, how much cloth 1¼ yards wide ought 12 ozs. to make ?

2. If the wages of 13 men for 7½ days amount to £13 7s. 0½d., how many men ought to work for 24 days for £173 8s. ?

SECTION VII.

1. Which is the greater, and by how much, of the following quantities—1⅝ of 1 ton 11 lbs. ; or 3⅞ of 11 cwt. 6 lbs. ?

2. A lady having spent ⅕ of her money in one shop and ¼ of it in another, had left £3 17s. What sum had she to start with, and what decimal of that sum is the amount which she had left ?

SECTION VIII.

1. Find the value of ·45 of £1 13s., and convert into vulgar fractions 2·345, and ·5220.

2. How many oranges at £·084375 per dozen ought to be given in exchange for 378 eggs at ·0,625s. each ?

SECTION IX.

1. In what time will £56 5s. amount to £64 2s. 6d., at 3½ per cent. per annum, simple interest?

2. A confectioner gained 60 per cent. by selling sugar candy at 1¼d. per oz.; what per cent. would he have gained or lost by selling it at 8d. a lb.?

ANSWERS.—SCHOLARSHIP EXAMINATION.

FEMALE CANDIDATES.

Arithmetic.

SECTION I.

1. No. of feet = 25000 × 1760 × 3

4 | 176000
44000000
× 3
Ans. 132,000,000

2.

Tons.	cwt.	qrs.	lbs.
4	17	3	18
2	3	3	15
13	9	2	25
22	18	3	19
133)43	10	1	21(

20
870(6 cwt.
798
72
4
289(2 qrs.
266
23
28
184
46
21
665(5 lbs.
665

Ans. 6 cwt. 2 qrs. 5 lbs.

SECTION II.

1.

	£	s.	d.	
733½ at	2	18	6	× 3
			10	
	29	5	0	× 3
			10	
	292	10	0	
			7	
	2047	10	0	
	87	15	0	
	8	15	6	
	0	14	7½	
	2144	15	1½	
	1086	10	10½	
Ans.	£1058	4	3	

	£	s.	d.	
751½ at	1	8	11	
			10	
	14	9	2	
			10	
	144	11	8	× ½
			7	
	1012	1	8	
	72	5	10	
	1	8	11	
	0	14	5½	
	£1086	10	10½	

2. 6½d. per lb. is 6½d. × 112 per cwt.
i.e., 728d. per cwt.
i.e., £3 0 8 per cwt.
1 19 6
Profit per cwt. is £1 1 2

Hence we have to find the value of 7 cwt. 1 qr. 14 lbs. at £1 1s. 2d.

	£	s.	d.
	1	1	2
			7
	7	8	2
1 qr. = ¼ cwt.	0	5	3½
14 lbs. = ½ qr.	0	2	7¾
	£8	4	1½

SECTION III.

1.

	s.	d.		£	s.	d.
3½ cwt. of coals at	0	10½	is	0	3	0¾
13 lbs. ,, cheese ,,	0	7¾	,,	0	8	4¾
2¾ lbs. ,, tea ,,	3	3	,,	0	8	11¼
17 lbs. ,, sugar ,,	0	5½	,,	0	7	9½
8½ yds. ,, flannel ,,	1	11½	,,	0	16	7¾
29 yds. ,, calico ,,	0	10¾	,,	1	5	11¾
				3	10	9¾
Money paid				5	0	0
Change required				£1	9	2¼

2.

	£	s.	d.		£	s.	d.
64 yds. sheeting at	0	1	2½	is	3	17	4
4 prs. blankets ,,	0	18	4	,,	3	13	4
3 ,, ,,	0	12	0	,,	1	16	0
18½ yds. silk ,,	0	5	6	,,	5	1	9
26 yds. huckaback ,,	0	0	10¾	,,	1	3	3½
4 cloths ,,	0	19	6	,,	3	18	0
5 ,, ,,	1	6	6	,,	6	12	6
⅓ doz. string ,,	0	1	6	,,	0	0	6
					26	2	8½
Discount					1	11	6
					24	11	2½
Money paid					30	0	0
Change required					£5	8	9½

SECTION IV.

1.

	£	s.	d.	
89 lbs. 9 oz. at	2	14	6	× 9
			10	
	27	5	0	
			8	
	218	0	0	
	24	10	6	
8 oz. = ½	1	7	3	
1 oz. = ⅛	0	3	4⅞	
	£244	1	1⅞	

2. 13s. 4d. is £⅔ ∴ 13s. 4d. in £ is ⅔ of rateable sum.

	£	s.	d.		£	s.	d.
13s. 4d. on	1710	16	8	is	1140	11	1⅓
½d. in £ on	1710	16	8	,,	3	11	3 5/12
Value of rate					£1144	2	4¾

The last item is calculated thus:—

½d. in £ on £1710⅚ is ½d. in 1d. on 1710⅚d.
i.e., is ½ (1710⅚)d., *i.e.*, 855 5/12.

SECTION V.

1.

		£	s.	d.
Poor rate on £63	is	2	8	6¾
£7	,,	0	5	4¾

	£	s.	d.
£1904 is 272 ×	0	5	4¾
			8
	2	3	2
			34
Ans.	£73	7	8

2. 5 lots go for £40 7s. 11d.
1 lot goes for £8 1s. 7d.
$34\frac{5}{8}$ bushels for $£8\frac{19}{240}$
$\frac{277}{8}$ bushels for $£\frac{1939}{240}$
1 bushel for $£\frac{7}{30}$
1 quarter for $\frac{8 \times 7}{30}$
100 quarters for $£\frac{560}{3}$ *i.e.*, £186 13s. 4d.

SECTION VI.

1. 24 lbs. of wool make 115 sq. yds. of cloth.
12 oz. ,, $\frac{1}{32} \times 115$ sq. yds.
But the cloth is 1¼ wide

$\therefore$ it is $\frac{4}{5} \times \frac{1}{32} \times 115 = \frac{23}{8}$ yds. long.

Ans. 2 yds. 2 ft. 7½ in.

				£	s.	d.
2.	13 men in	$7\frac{1}{2}$ days	get	13	7	$0\frac{1}{2}$
	1 man in	$7\frac{1}{2}$,,	gets	1	0	$6\frac{5}{8}$
	1 ,,	29 ,,		4	2	2
	1 ,,	1 ,,		0	2	10
	1 ,,	24 ,,		3	8	0

∴ No. of men is $\frac{2448}{48}$ or 51.

SECTION VII.

1. $1\frac{3}{5}$ of 1 ton 11 lbs.

		ton	cwt.	lbs.
1	=	1	0	11
		5	0	55
$\frac{3}{5}$	=	0	11	$18\frac{3}{5}$
$1\frac{3}{5}$	=	1	11	$29\frac{3}{5}$

		cwt.	lbs.
$3\frac{2}{5}$	of	11	6
			3
		33	18
2		22	12
$\frac{2}{5}$		4	$47\frac{1}{5}$
		37	$65\frac{1}{5}$
		31	$29\frac{3}{5}$
Second is greater by		6	$35\frac{3}{5}$

6 cwt. 1 qr. $7\frac{3}{5}$ lbs.

2. She evidently had $(1 - \frac{1}{5} - \frac{1}{4})$ of her money left, *i.e.*, $\frac{11}{20}$.

∴ $\frac{11}{20}$ of her money is £3 17s.

∴ her money is £7

£3 17s. is $\frac{11}{20}$ of £7, *i.e.*, $\frac{55}{100}$ or ·55.

SECTION VIII.

1. $\cdot 4\dot{5} = \frac{45}{99} = \frac{5}{11}$.

$\frac{5}{11}$ of £1 13s. is 5 × 3s., *i.e.*, 15s.

$2\cdot 34\dot{5} = 2\frac{342}{990} = 2\frac{38}{110} = 2\frac{19}{55}$

$\cdot 522\dot{0} = \frac{5168}{9900} = \frac{1292}{2475}$

2. 378 eggs at ·0625s. each

at ·7500d. each

i.e., at $\frac{3}{4}$d. each

are $\frac{567}{2}$d.

£·084375 = 20·25d. = $20\frac{1}{4}$d.

$20\frac{1}{4}$d. is contained in $\frac{567}{2}$d. 14 times.

∴ the answer is, 14 doz. oranges.

SECTION IX.

1. Working sum backwards,

£	s.	d.	
64	2	6	amount.
56	5	0	principal.
£7	17	6	interest.

Obviously number of years $= \dfrac{£7\ 17s.\ 6d. \times 100}{3\frac{1}{3} \times £56\ 5s.} = 4$

2. $1\frac{1}{4}$d. per oz. is 20d. per lb. He gains 60 % ∴ selling price is $\frac{160}{100}$ or $\frac{8}{5}$ of buying price. ∴ value of candy is $\frac{5}{8} \times 20 = \frac{25}{2}$d. per lb. *i.e.*, $12\frac{1}{2}$d.

If, therefore, he sells at 8d.,

on every $12\frac{1}{2}$ he loses $4\frac{1}{2}$

,, 100 ,, $8 \times 4\frac{1}{2}$ or 36.

Ans. Loss of 36 %.

(N.B.—If, in looking through this work, any reader detects an error, we shall be glad to be apprised of it. Through press of time, the whole has had to be put together in an hour or two.)

—o—

Publications Received.

Astronomy—

(1) Browne's Astral Origin of Hebrew Emblems. E. Stanford.

Composition—

(1) Wood's Analytic Test Exercises and Examples. J. Marshall and Co.

Domestic Economy—

(1) Floyer's Needle Drill, Position Drill, and Knitting-Pin Drill. Griffith and Farran.

English Literature—

(1) Poetry for the Young. Part I. Griffith and Farran.

Geometry—

(1) Walmsley's Introduction to Geometry. Hodgson and Son.

Latin—

(1) Dodd's Matriculation Latin. W. Stewart and Co.
(2) Gibson's Limen Latinum. Relfe Bros.

Mathematics—

(1) Langton's Examples in Arithmetic. Standards V. and VI. T. Murby.
(2) Sparke's Inductive Algebra. W. Stewart and Co.

Miscellaneous—

(1) Clifford's What Her Majesty's Inspectors Say. North of England School Furnishing Company.
(2) Story's School Board Gymnastics. L. N. Fowler.
(3) Kiddle and Schem's Dictionary of Education and Instruction. Sampson Low and Co.

Mechanics—

(1) Watt's Mechanical Industries Explained. W. and A. K. Johnston.

Music—

(1) McCartney's Selections from the Poets set to Music. R. J. Derfel.
(2) McCartney's Musical Drill. G. Gill and Son.

Periodical Literature—

(1) Ward and Lock's Universal Instructor, XIII. Ward, Lock, and Co.
(2) Our Little Ones. Vol. II. No. 1. Griffith and Farran.

Prize Books—

(1) Our Little Ones. Griffith and Farran.
(2) Holly Berries. Griffith and Farran.
(3) Kingston's Peter the Whaler. Griffith and Farran.
(4) Ludgate Hill, Past and Present. Griffith and Farran.
(5) Knight's Rocket. Nelson and Sons.
(6) Schwatka's Search for Franklin. Nelson and Sons.
(7) Hoare's Tempered Steel. Nelson and Sons.
(8) Geddie's Beyond the Himalayas. Nelson and Sons.
(9) Alpine Climbing. Nelson and Sons.
(10) Wilson's Great Heights. Nelson and Sons.
(11) Surr's Stories about Dogs. Nelson and Sons.

Scripture—

(1) Ottley's Church Teaching for Sunday Schools. National Society.
(2) Benham's How to Teach the Old Testament. National Society.
(3) Yonge's How to Teach the New Testament. National Society.
(4) Yonge's Practical Work in Sunday Schools. National Society.

School Management—

(1) Prince's School Management and Method. J. Heywood.

Science—

(1) Stoker and Hooper's Matriculation Chemistry. W. Stewart and Co.
(2) Gardiner's Acoustics, Light and Heat. J. Heywood.

Theology—

(1) Thomas's Synopsis of Butler's Analogy of Religion. T. Murby.

Writing—

(1) Tidmarsh's Modern Copy Books. Longmans, Green and Co.

Recent Inspection Questions.

[The Editor respectfully solicits contributions—all of which will be regarded as STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.]*

Arithmetic.

STANDARD I.

(1) From two hundred and one, take one hundred and ninety-eight. Ans. 3.

(2) Add together,—five hundred and nineteen, eight, six hundred and twenty, seven hundred and thirty-eight, and three hundred and fifty-one. Ans. 2,236.

(3) From eight hundred and fifty, take six hundred and thirty. Ans. 220.

(4) Add together,—eight hundred and ninety, two hundred and six, fifty-seven, one hundred and twelve, and six hundred and ten. Ans. 1875.

STANDARD II.

(1) From eighty thousand and thirty-seven, take thirteen thousand eight hundred and ten. Ans. 66,227.

(2) Divide fifty thousand and fifty-two by twelve. Ans. 4,171.

(3) Multiply five thousand three hundred and sixty-four by five hundred and forty. Ans. 2,896,560.

STANDARD III.

(1) Add together,—sixty-three thousand and seventy-one pounds fifteen shillings and eightpence farthing, forty thousand and nine pounds and elevenpence three farthings, four hundred thousand and eleven pounds nineteen shillings and sevenpence farthing, fifty pounds twelve shillings and ninepence halfpenny, and seven hundred thousand four hundred and thirty-two pounds eleven shillings and a penny three farthings. Ans. £1,203,576 0s. $2\frac{1}{2}$d.

(2) Find the difference between one hundred thousand one hundred pounds one shilling and sevenpence, and ninety thousand six hundred and one pounds eleven shillings and fourpence halfpenny. Ans. £9,498 10s. $2\frac{1}{2}$d.

(3) Divide four hundred and forty-seven thousand eight hundred and fifty, by seventy-four. Ans. 6,052—2.

STANDARD IV.

(1) How many minutes has a boy lived who is 12 years old? (Do not neglect leap years). Ans. 6,311,520.

(2) Divide two million and twenty thousand and twenty pounds one shilling and one penny by one hundred and sixty-four. Ans. £12,317 3s. $10\frac{3}{4}$d.—104 remain.

(3) Multiply £480 19s $7\frac{1}{2}$d. by 1,706. Ans. £820,554 0s. 3d.

STANDARD V.

(1) How much change should you get if you gave a £10-note in payment of the following bill—56 table books @ 4 for 6d., 8 doz. geographies @ $2\frac{1}{2}$d. each, 3,750 pencils @ 9s. 6d. per 1,000, 72 rulers @ 1s. $4\frac{1}{2}$d. per doz., 26 atlases at 4s. 3d. each. Ans. 18s. $7\frac{1}{2}$d.

(2) Find the cost of 13 cwt. 2 qrs. 21 lbs. @ £5 18s. 6d. per cwt. Ans. £81 1s. $11\frac{5}{8}$d.

(3) If 113 tons of coal cost £119 14s., what should be the cost of 19 tons? Ans. £20 2s. $6\frac{42}{113}$d.

(4) A man bought 744 oranges @ 9d. per doz., at how much each must he sell them so as to gain 15s. 6d.? Ans. 1d each.

STANDARD VI.

(1) Find the value of $\dfrac{(2+\frac{1}{5})\div 3\frac{1}{2}}{\frac{1}{2}-(\frac{1}{3}\text{ of }\frac{4}{7})}$ Ans. $2\frac{2}{65}$.

(2) Take ·125 of 10s. from ·375 of 13s. 4d. Ans. 3s. 9d.

(3) If 14 horses can be kept 10 days for £15, how many can be kept 21 days for £18? Ans. 8 horses.

(4) After 9 gallons have been drawn off from a cask it is $\frac{2}{5}$ full. How many gallons can it hold? Ans. 15 gallons.

Dictation and Grammar.

STANDARD II.

Dictation.—A fire on land is a terrible thing, but a fire at sea is much more terrible. On land we may, perhaps, get out of its way, but at sea there is often no chance of escape.

Grammar.—Underline the nouns in the above.

STANDARD III.

Dictation.—Sometimes the tiger, when hunted, springs upon the elephant and fastens his teeth and claws in his neck or shoulder. The latter tries to kneel on his enemy, so as to crush him by the weight of his great legs and heavy body. Sometimes they both roll on the ground, and a fearful struggle follows, generally, however, ending in the death of the tiger, either from the strength of the elephant, or by a bullet from the hunter's rifle.

Grammar.—Write out a list of nouns and verbs in the above.

STANDARD IV.

Dictation.—It was a perilous undertaking, yet he must obey; and the men began their terrible march, through narrow defiles, past overhanging precipices, six thousand feet up, up, up, among the gloomy solitudes of the Alps. The cannon were placed on rough sleds, each drawn by a long team of soldiers, or, when the roads permitted, by oxen, and the ammunition was packed on mules.

Grammar.—Name the parts of speech in the following passage:—All hands were soon on deck, looking at it, and admiring in various ways its beauty and grandeur.

STANDARDS V. AND VI.

Grammar.—Parse and analyze:—

(A) Well had the boding tremblers learnt to trace
The day's disasters in his morning face.

(B) Full well they laughed with counterfeited glee
At all his jokes, for many a joke had he.

The Practical Teacher.

A MONTHLY EDUCATIONAL JOURNAL.

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It would save time and expense if subscribers when remitting would state exactly what numbers they wish to be sent.

To Correspondents.—All literary communications should be addressed, THE EDITOR OF THE PRACTICAL TEACHER, Pilgrim Street, Ludgate Hill, London, E.C.

Accepted contributions are paid for within twenty-one days of publication.

The Editor cannot return rejected MSS.; authors should therefore retain copies.

*** *We regret that, owing to the great pressure upon our space, the 'Monthly Notes' and 'Gossip' are again crowded out.*

We learn that the next Examination for Certificates will be held at the London Institute for the Advancement of Plain Needlework, 2, Connaught Street, Edgware Road, on Saturday, December 10th, 1881, at 11 a.m. Persons desirous of being examined are requested to apply to the Principal, at above address.

***

We hear that the North of England School Furnishing Company, Limited, of Darlington and Newcastle-on-Tyne, have purchased the goodwill, patents, etc., of the firm of Colman and Glendenning, of Norwich. The services of Mr. John Glendenning have been also retained by the Company.

Publications Reviewed.

*** We are sorry to disappoint the many friends who desire us to quote the price of each work noticed in our columns. This we would respectfully point out is the publishers' duty and not ours; we give publicity enough to a book when we review it. Our readers should peruse the advertisements in our pages, and failing to find the price here, it would be no great trouble or expense to drop a line to the publishers whose name and address we will gladly give.

Lectures on Teaching. By J. G. Fitch, M.A. Cr. 8vo, 436 pp. London: Cambridge Warehouse, 17, Paternoster Row.

SECOND NOTICE.

On Writing we need say little. As one of Her Majesty's Inspectors, Mr. Fitch asserts: 'There are, in fact, no bad writers in an elementary school of the best class,' and he shows that 'a good method steadfastly carried out is infallibly efficacious even in the worst cases,' in securing a good handwriting.

The difficulties of teaching 'Reading' and Spelling on account of the anomalies of our so-called orthography, are discussed at length and to good effect. But, while these are familiar to all teachers, the methods for overcoming them are not so well known. Reading is largely a mechanical process, and, therefore, may be greatly assisted by appliances. 'A good reading-book,' says Mr. Fitch, 'should (1) be well printed in sufficiently large type to make it very easy for the child to put his finger to each word as he pronounces it. (2.) It should be made attractive by pictures, and by the pleasantness and interest of the subject. This is of first importance. (3.) The lessons should not be graduated by so mechanical a rule as the mere length of the words and the number of syllables... (4.) Many of the lessons should be narrative and in the form of dialogue, giving some play for changes of voice... (5.) Every lesson should contain, at least, two or three words which are a little beyond the child's own vocabulary... One of the first objects of a reading lesson is to enrich the scholar's store of words.'

These remarks are quoted for the benefit of young teachers, who are almost bewildered by the number of the reading-books brought under their notice. Mr. Fitch is, we believe, a safe guide in such an important matter. He insists that anomalous words should not occur in early lessons, and that the 'real gradation' depends 'on the number of anomalies' in the words introduced.

The proper mode of using such a 'good book' both for reading and spelling is given in instructive detail. The author says further on: 'Spelling is a matter for the eye, not for the ear;' and 'the person who spells well is he who carries in his memory a good visual impression of the picture of the word.' We are therefore surprised to read (p. 213) as an 'obvious truth,' 'that it is mainly by writing that spelling is to be taught.' The Dictation exercise we think is only a *test* of ability to reproduce 'the picture of the word.' Spelling was never *taught* by dictation.

Mr. Fitch's summary of rules for 'expressive reading' are valuable, as are also the suggestions on the use of

words in 'oral expression,' or, as we might call it, *viva voce* composition (p. 219). So much of a child's school life is commonly spent in learning to read and write, that every 'practical teacher' will avail himself of any hint which tends to the more rapid and effective acquisition of these 'instruments of sense-training.' Many such hints are given in this lecture.

Having discussed the value of linguistic studies generally, the author maintains in the ninth chapter that the study of our own tongue deserves more respectful treatment than it receives even in our higher schools, and points out that when no other language is taught it is an indispensable educational instrument. The value of rules to teach the 'art of speaking and writing the English language with propriety' is shown to be practically *nil;* and though Mr. Fitch seems not to be aware that suoh faults as, 'Give I the book,' 'Send the money to he,' do exist in the vernacular of the West, all will allow that 'speaking with propriety' results from imitation and habit, and not from the rules of grammar. Yet if 'English Grammar' be made to include 'the logic, history, formation, and relation of words, it will designate one of the most fruitful and interesting of school studies.' Mr. Fitch insists on the application of the analytical method to a vernacular language, and gives a series of suggestive illustrations. 'One essential object contemplated in the study of our own language is a knowledge of the meanings of its words.' This is 'closely connected with grammar,' and practice in the use of words in various combinations in oral or written composition is, in our opinion, of the greatest value to all. In the case of those children who, as in most of our primary schools, do not remain at school long enough to study much grammar, this mode of acquiring an enlarged and exact vocabulary must be far more useful than the parsing exercises on which they vainly spend so much precious time. An example of one convenient mode of writing out the analysis ot sentences is given at length, and this lecture concludes with some directions as to the study of literary masterpieces and as to the means of imparting an enthusiastic love of reading which should be the chief purpose of lessons in English literature.

A History of the British Empire. By E. Sanderson, M.A. London: Blackie and Son, Old Bailey.

This book of nearly 450 closely yet remarkably well-printed pages contains an immense accumulation of facts, together with forty-eight columns of names with dates, and also a dozen pages of a useful chronological table. These facts and tables constitute the chief merits of the book, which, though fairly and evidently carefully written, yet fails in some very important particulars. Mr. Sanderson writes too much in the beaten track that has been shown to lead to error by modern research. A more diligent attention to the valuable labours of recent investigators, would have enabled the author to have avoided repeating oft-refuted errors. In commencing with the ancient Britons we have the usual vague statements about these people being at the time of the Roman invasion in a state of semi-barbarism, clad in skins, living in poor huts, and all the rest of such antiquated nonsense, including the notion that the weapons of flint and bronze were used by these Britons, instead of being referred back to their ancestors some thousand years at least before Julius Cæsar's time. The old story of the Britons being either extirpated or driven into the corners of Wales, Cornwall, and Scotland, is again told, as if no such writers as Pyke, Palgrave, Huxley, and Nicholas had dispelled such nonsensical conclusions from the vagaries of the shadowy Gildas. No notice is taken of the high intellectual development of the Druids, nor of the populousness and flourishing condition of the pre-Roman Britain in general. Some few words are given as heir-looms of the Celtic speech without any apparent suspicion on part of the author that words in our language traceable to a Celtic source may be reckoned by hundreds. The beautifully drawn figures illustrative of the Druids might suggest a doubt of the sweeping condemnation of their teaching being a mere gloomy and superstitious paganism tinged with horrible cruelties. Leaving this period, the author says, 'We may as well dispose of the well-worn and erroneous name, *Saxon Heptarchy*, by stating that there never were, at any one time, seven independent Saxon and English kingdoms.' This will be new to many writers who have strongly contended for eight and adduced grounds for several other small independent governments.

The general sketch of the Saxon period is fairly written, together with the social condition of the people. Alfred, of course, comes in for a large share of well-deserved praise, but we have been so accustomed to think about Alfred's good qualities as to become sceptical of his having had any bad ones. Yet it is indisputable that Alfred would have been benefited had temperance been a Saxon virtue. The same disposition to praise shows itself in many other instances with amiable obliviousness to failings. With so much attention to condensation of facts, however, the author has not much scope for argument or anything like detailed criticism.

Now, as the auctioneers say, 'with all faults,' the book before us will be of considerable service, and mostly, as we have said, as a valuable compendium of facts. The illustrations are for the most part remarkable examples of artistic excellence and appropriateness. We would particularly refer to the Druids, the head of Julius Cæsar, the figure of John Hampden, and some ships of various periods. We cannot award the same praise to the maps which are mostly dull and indistinct, with the exception of a remarkably clear one (at page 136) to illustrate the Wars of the Roses, and some other plans of battlefields. Some of the topographical views too are most excellent, as for example that of Sebastopol (p. 390), the Khyber Pass (p. 412), and Gibraltar (p. 283). Such illustrations are real aids to the understanding of the subject of the matter. The plan of the field of Waterloo (given on p. 362), helps more to the understanding of this notable contest than a very lengthy description. The view of the Bastille, also (p. 329), calls up a host of associations, and will be welcomed by all readers of modern French history. The story of India and its annexation to British rule is ably told. The same may be said of the American Revolution and its results. A remark respecting General Monk being specially designed by Providence for the safety of England led us to expect a very favourable if not flattering description of Charles II. But we were agreeably disappointed. This worthless king is duly held up to scorn and reprobation. 'He came back to England with the fixed purposes of being as independent of his Parliament and his people as he dared be, and of making up for past trials by a life of selfish ease and enjoyment. He cared not what he did, how he degraded the nation and himself, so long as these two objects could be obtained. It was for this that, when he wanted money, he sold the national honour and national possessions, and became the pensioner of Louis XIV., of France. . . . . . He was full of wit, good humour, vivacity, and affability. He had but little heart, tenderness, virtue or conscience. He had no belief in women's virtue or men's honour. . . . . . He was graceful and gentlemanly, with harsh swarthy features, but a pleasing expression. His real politeness and easy gaiety of air and conversation, charmed all who approached him. He was always popular.' This and more equally to the purpose, shows that Mr. Sanderson is capable of well describing matters of which he speaks from a full mind. The failure of the early portion of the book arises from the author's not giving such attention to the best sources of information that he has devoted to the later details of British history. On topics evidently congenial to the author he is rather apt to get into the 'high falutin style of fine writing. For this we are not altogether unprepared by his telling us in the preface of his intention 'to rise, upon occasion, to eloquence.' These occasional bursts hardly harmonise with the severe compression of facts

that mark many pages. Everybody was glad to see the end of the old window tax, but few would speak of this as 'a foolish and cruel impost, which deprived many people of a due share of heaven's free light and air within their homes.' The following example of Macaulay-and-water is almost too much for our poor weak heads:—'In truth, we are living in an age of wonders. The most familiar facts, the seen and felt realities of daily life, leave far behind the wildest dreams of fancy and of fiction. Electric fires, lighting our streets from sunset until dawn; the photograph that makes the sun's rays print with faultless accuracy the features of man, or the charms of the landscape, or the beauteous lines of painting and sculpture, or the massive glories of the architect and of the engineer; the roadways bored through mountains, the bridges flung for railways over straits and rivers, spanning alike smooth stream and ruffling tide; the floating fort—with twenty-inch iron armour on its sides; the cannon firing shot that weighs almost a ton; the rifle raining bullets out at twelve a minute, with low and deadly aim in practised hands; the drug that deadens pain, and makes unfelt the surgeon's dreaded knife, these, and a thousand other things of use and beauty, of marvel and delight, belong to the half-century of invention and construction and discovery, whose students and philosophers and engineers are still inventing, and discovering, and constructing with more restless energy than ever.'

Not much is gained by such rhetorical flourishes. Very much of the same highflown rhapsody might be applied to the days of the invention of printing, of the Reformation, of the Revolution, and of almost every notable epoch. We question, however, its suitability in a school history of England.

Murby's Scripture Manuals. The first Epistle to the Corinthians. By a Practical Teacher. London: Murby, Fleet Street.

This little manual will be valuable to students preparing for the university local examinations, and for pupil teachers who have to go through a theological course of study. The recommendation of the author for the student to read the text through 'carefully and thoughtfully again and again, to the twentieth time,' must be taken *cum granum salis*. Doubtless it would be well to read every book worth reading in this manner, but time and opportunity being insufficient to carry out such, their value may be questioned. We may say that this manual will help the student to form opinions and acquire the grasp of the contents of this epistle much better than could be done by all his efforts without some such aid. We should hardly understand ver. 22, chap. xv.: 'For as in Adam all die,' etc., to prove the resurrection of the natural or material body. This is plainly discountenanced by the explanation to ver. 41, 'NATURAL BODY,' *i.e.*, the human body in which the soul now lives. This animal body, which decays in the grave, is contrasted with the spiritual body, which will be raised.' We may indeed trace the material view of the resurrection to ignorance of the Apostle's expression, 'There is a natural body and a spiritual body,' and the failure to see that the spirit not only has form and spiritual substantiality, but greatly influences the form of the natural body, as is exemplified by the very look of a good man in contradistinction from a bad one. The want of due appreciation of the Apostle's meaning has led to the materialistic view of the resurrection, which has been a stumblingblock to many. The examination questions with which this useful little manual concludes are remarkably good.

A Synopsis of Butler's Analogy of Religion. By the Rev. R. O. Thomas. London: Murby, Bouverie Street.

We have had occasion to commend the labours of Mr. Thomas in his useful outline of 'Paley's Evidences,' and his skill is no less shown in the useful compendium before us. Important as have been the advances in Biblical criticism and natural theology, these great books of Paley and Butler yet retain their leading positions. No student can afford to neglect them, and the profit their reading develops in regard to lucidity and demonstrativeness no one can gainsay. The synopsis before us is a readable book and gives no unpleasant signs of being an abridgment of a larger treatise. Of course there are summaries interspersed as guides to the leading features of Butler, but the condensation generally is so well done as to convey no sense of incompleteness. To attempt to criticise Butler in a short notice of this synopsis would be sheer impertinence, but while Mr. Thomas has in a hundred pretty closely printed pages fairly introduced us to Butler he often also most judiciously shows how more detailed reading may be advantageous to the student. The few sections of examination questions are remarkably good.

Bell's Reading Books. Select Tales by Maria Edgeworth. London: George Bell and Sons, Covent Garden.

We are said to be making great advances in educational literature. But the past generation were not altogether in the helpless condition that many would fancy. An age that had Mrs. Barbauld, Miss Edgeworth, in addition to the ever welcome 'Robinson Crusoe,' and 'Evenings at Home,' were by no means ill-provided with intellectual food. The inculcation of lessons of industry with which Miss Edgeworth begins her tale of 'Lazy Lawrence,' over whom the example of the 'Industrious Jem' at last prevails, is infinitely more likely to enlist the sympathies of youthful readers on the side of honesty and industry than much dogmatic teaching and preaching.

Of course, everybody knows that the charm of Miss Edgeworth's tales is their naturalness and simplicity. There is nothing forced in the character of Jem or his steps to success, nor in the downward career of his counterpart. At the same time the story is developed into an interesting ending, and the detection of the youthful robbery is as natural and probable as every other feature.

Next we take up the capital story for schoolboys of Tarlton, and at once see how poor Loveit's indecision will end. The unswerving uprightness of Hardy is, perhaps, less skilfully portrayed than the blandishments, mockery, selfishness, and thorough cowardice of Tarlton. We become increasingly interested as the tale proceeds, and feel the usual relief at Hardy's innocence being established and Tarlton expelled with ignominy. The story of Susan is more ambitious, being a well-developed novelette. Here, again, the trials of Susan and her father and mother at once enlist the reader's sympathy, while indignation is equally roused against the temporary success of the artful schemer and trickster, Lawyer Case. There can be no question regarding the value of thus engaging the sympathetic interest of youth on the good side, and to see also that though the right path may be for a time overshadowed by clouds, yet these will clear away and leave those who walk uprightly to enjoy the cheering sunshine. Doubtless dogmatic teaching has its place; moral lessons should not be omitted; higher appeals may come in at appropriate seasons; but the good effects of such tales as Miss Edgeworth's, wherein the moral is not thrust unduly forward, nor the 'goody goody' preachments made predominant, are unquestionable.

We may add that Messrs. Bell have brought this book out in a cheap form. No fault can be found with the printing nor with the binding, though plain. But we have a schoolboy's hankering to see these tales accompanied with such illustrations as the publishers have added to their edition of the 'Pilgrim's Progress.'

Home Gymnastics. For the Preservation and Restoration of Health. By T. J. Harletius, Stock holm. Translated by C. Löfving. London: Isbister, 56, Ludgate Hill.

We have not quoted the title of this book in full, but probably stated enough to indicate its design, which is to

prevent, if possible, and in many cases to try to cure bodily ailments by exercise. This, usually laid down on very broad or general principles, is here detailed and applied in a systematic method. The general influence of bodily exercise in regard to the healthy condition of the human organism is described in reference to the blood, the functions of digestion, respiration, and the secretions, together with the general nervous system and condition of life. This is followed by a description of movements for specific purposes to strengthen organs or parts of the body requiring additional exercise, or rather exercise to make up for the deficiency of bodily activity consequent upon sedentary occupation.

The book opens up the whole question of the conditions of health by showing how this may be best preserved by judicious muscular exercise. By the neglect of this various parts become more or less congested, and functional activity impeded. To remove these evils recourse is had to medicine, generally of a purgative nature, n order to prevent the blood becoming more impure by the absorption of food in excess of the quantity required by lethargic muscular action. This continued resort to medicine in time plays sad havoc with the digestive powers, and is a mere temporary relief from the evils of inactivity. Exercise, however, though wisely recommended as a preventative, often fails from being insufficiently specified and carried out in reference to the evils to be remedied or the particular muscles to be strengthened. In the book before us the most prevalent forms of disease are described, and the kind of exercise detailed for cure or prevention. Diagrams are given in all cases to illustrate the directions. In several cases a series of prescriptions are given, beginning with a series of easily performed movements and progressing towards difficult ones—the latter not to be undertaken, of course, till health and strength warrant the performance. Too frequent changes are to be guarded against, and, generally speaking, a higher exercise should not be attempted till the salutary influence of an easy one becomes diminished. Of course, the general free play of muscular activity is the mainspring of vitality in youth, but systematic exercises are by no means thus rendered superfluous. It is only by the judicious action of all the muscles of the body that the harmonious development of all parts is secured and a one-sided inequality avoided.

Physical education is now happily receiving its due share of attention. Our young scholars will become less specimens of the 'all head and no body' examples that formerly formed the majority of pupils. In many cases life was shortened, and in all rendered less happy and healthy by the want of physical exercise. The no less serious evil of bad ventilation is also receiving due attention, together with the alleviation of old physical errors that often degenerated into positive torture.

The chapter on swimming forms a good ending to this altogether excellent book, which ought to be 'strongly recommended by the faculty.'

Limen Latinum. A Latin Book for Beginners. By C. H. Gibson, M.A. London: Relfe Bros.

We have carefully perused this book, and the result of our investigation is completely satisfactory. We were indeed taken with the general appearance and get-up of the book, before we proceeded to read. It is beautifully and clearly printed on fine paper, and distinctive types, so essential to a work of this kind, are adopted. Mr. Gibson possesses two qualifications, which are indispensable to writers of educational books for beginners—scholarship and experience. It is now universally admitted that as much, if not more experience is necessary for teaching the young; and the same rule, we take it, applies to educational writers for the young. As Mr. Gibson sets forth in his preface, its great merit is its simplicity combined with its practicability. He has gone on the lines of the well-known Public School Latin Primer, but he has presented the grammar covered by that book in a better, simpler and more systematic method. One of the great faults of the old primer, we think, is the excess of notes in the shape of small print. This confronts the beginner, not only after he has gone on with the book for some time, but even at the threshold. This stumbling-block has been removed in the work before us, and what is most important the matter contained in the small print before alluded to is put in a simple and readable form. The grammar, as we said above, is more systematically arranged. We will give one instance of this. The Calendar in this book is placed in its natural position next to the numerals. In the Public School Latin Primer, such was our perhaps unpardonable ignorance in our early days, we knew not of the existence of a Calendar, and we were awakened to a sense of our iniquity by having it pointed out to us somewhere at the end of the book, relegated to an appendix along with another mass of small print. And the rules, being of importance, are boldly printed, and clear illustrations given. The same plan of natural arrangement is pursued throughout the book. We think we can discover the reason of an apparent deviation. The compounds of the Relative and Indefinite Pronouns are placed at the end of the book to avoid distracting the minds of boys who have just been hard at work on Pronouns in their great variety of forms.

But we have not properly pointed out the plan of the book, till we state that it is a combination of grammar with exercises thereon. In the exercises, as in the grammatical portion, Mr. Gibson has bestowed much careful attention.

The old cry against exercises was that they were uninteresting—nay, in many cases they were absolutely childish. We can most of us remember the ancient 'Balbus is building a wall,' 'Cæsar runs,' and the like. Mr. Gibson has followed the plan adopted by Dr. Bradley in his book on Latin Composition, and has given us for the most, examples taken from Latin authors, thus making them as interesting as possible. The exercises too on the different rules are remarkably full and at the same time carefully graduated. By no means the least important feature of the book is the copious vocabulary—Latin-English and English-Latin at the end of the book. Two or three meanings are in many cases supplied to a word, and other information is invariably added. In conclusion, we have only to say that the book has been written throughout with great care and the quantities of the Latin words carefully marked. We should be glad to see a Greek Grammar treated on the same basis, for we are sure that it would meet with as much approval as this must at the hands of those who have the education of the young to attend to.

What Her Majesty's Inspectors Say. Darlington: North of England School Furnishing Co.

We congratulate Mr. Clifford upon the appearance, for the second time, of his carefully-prepared digest of the English and Scotch Blue-books entitled, 'What Her Majesty's Inspectors Say,' and issued by special permission of the Education Department. Those of our readers who are unfamiliar with the work will get the best idea of it if we quote the title page:

'What Her Majesty's Inspectors say—being their reports (1880-1881) for England, Wales, and Scotland, classified, paragraphed, and arranged in the following order:—Analytical Index, Preface, Reading, Writing, and Spelling, Arithmetic, Geography, History, Grammar, Literature, Music and Singing, Domestic Economy, Cooking, Needlework, Specific Subjects, Infant Schools, Evening Schools, Pupil Teachers, Discipline and Drill, School Premises, and Miscellaneous, with a copious summary, and an appendix consisting of the "Proposals for the New Code."'

We can confidently recommend the book; we should be glad to learn that it had found its way into the hands of every teacher and educationist in the kingdom.

Religious Knowledge Manuals: How to Teach the Old Testament. By W. Benham, Vicar of Marden, Stapelhurst. London: National Society.

No one can help admiring the spirit of this book, and the devout tone in which it is written. In regard to methods of teaching, Mr. Benham's remarks are more suggestive than methodically descriptive. Not that we regard this as an evil—scarcely a defect—as each teacher and student had better be left to the development of his own plans and resources than to be encumbered with details unsuitable to his taste or knowledge, which, like Saul's armour, would be more encumbrances than aids. In taking down notes, Mr. Benham wisely advises a short reference to the treatise or book in preference to the copying of long notes from books, which 'takes a long time, and generally you do not read them afterwards. Only make a reference, and that to works within your reach.' Again, 'Perhaps the time is gone by when children were made to read genealogies from Nehemiah by way of penance.' True, and well said, except that many mistaken teachers insisted on the learning of such lessons 'not by way of penance,' but out of a mistaken idea of edification. Some years ago a series of such painfully inappropriate lessons purporting to be written by a country vicar, were published in the monthly paper of the Society which now more wisely issues such books as Mr. Benham's. Another wise recommendation by Mr. Benham is to resort to pictorial aid as much as possible. In this there are abundant resources of the most attractive nature. There is scarcely an educational shop in which good Scriptural pictures may not be found, and some of these are of the highest artistic excellence. Many years ago the S.P.C.K. issued a series of outline drawings on large sheets, of a bold but well executed character. These were as useful for excellent drawing examples as also for Biblical teaching. Similar beautiful specimens are now issued by the Wesleyan publishing office, as well as by the National and Christian Knowledge Societies.

The list of lessons suggested by Mr. Benham is good and practical. These follow what may be termed the explanatory step, and give the most prominent Scriptural aids to lessons against *anger*, *envy*, *evil company*, *pride*, and other evils, and the value of *prayer*, *humility*, *justice*, and other virtues, together with the leading doctrines deducible from the Old Testament.

The latter half of Mr. Benham's book gives an outline of the leading features of Biblical history, including a summary of the rulers before, during, and after the Captivity. The dates affixed to this list will be very useful. Some of the latter portions of the book may be thought too sermonizing, but with so much to approve of, it would be ungracious to indulge in captious remarks. The price, too, is moderate, and the 'get up' unexceptionable.

The Young Student's English History Reading Book. London: National Society.

This book is the advanced part of a former volume, and is well adapted to its purpose. It is written with much more scholarly thoughtfulness than a host of the compilations that the New Code has called into existence. Where fulness of detail is unsuitable, suggestive hints are given by which the young student's course is well pointed out. Much greater attention has been given to domestic history than is commonly bestowed even in some books professing to treat of the condition of the people. Many of these sketches are remarkably well done, and bring the scenes described before the view so as to thoroughly command the reader's attention. In tracing the origin of our Teutonic ancestors the author very properly sweeps away the fallacies associated with the term *Saxon*. He attributes the correction of this popular error to Mr. Freeman; but several others have aided in clearing this portion of history. It was doubtless the Romans who first applied the term Saxon—the name of the southern tribe—to the other people of Northern Germany, and historians have, for the most part, since 'blindly or lazily fell in with this example, to the infinite misguidance and confusion of themselves and of their readers.' The Angles, though the last of the great tribes that came over, were by far the most numerous, and 'so clearly took the lead of the tripartite confederacy [of Jutes, Saxons, and Angles], that the whole body of the Teutonic invaders of Britain came to be known as Angles, or Englishmen.' All three tribes, as the author further remarks, spoke 'English,' not 'Saxon,' and the term Anglo-Saxon, then unknown, and only adopted after the Conquest, was a misleading afterthought. With so much that is interesting and original in the sketch of the Teutonic tribes, we regret that the attention of the writers was not equally directed to the earlier inhabitants—the Britons. But a reliable history of these people is still to be written. The author falls into the exploded error of the Britons being completely exterminated by the Saxons, notwithstanding the writings of Pike, Palgrave, Nicholas, and Huxley, together with the more irrefragible testimony of language, length of time occupied in completing the Saxon rule, and that of ethnology. The latter portion of the book is somewhat impaired by important omissions. Nothing is said of the great Free-trade legislation which for nearly a quarter of a century was the most prominent topic of English political life. The author professedly avoids treating of the events of the last ten years, probably with the desire to avoid irritating topics; but while the story of the Indian Mutiny is told, together with that of the Crimean War, room should have been found for some mention of the great fiscal change carried by Sir Robert Peel before his lamented death in 1850. We are aware that this book does not profess to be a consecutive history of England; but the student should be aided, as in other parts of this book, with hints for study of the topics omitted. Altogether this book cannot fail of giving new and vivid impressions in youthful readers of the most salient points connected with our national progress. The book is beautifully printed on excellent paper, and with type that makes reading not only easy but luxurious.

Johnston's Natural History Plates. London and Edinburgh: W. and A. K. Johnston.

We have received three of this series of plates, viz., that of the Donkey, the Pig, and the Roe or Red Deer. The series comprises some fifty examples already published, with a notice that others are in preparation. We are unwilling to speak otherwise than in unqualified admiration of a scheme of illustrations so liberally designed, and the publication of which must greatly aid the knowledge of Natural History. But we are impressed with a decidedly foreign look of the specimens before us, at least in regard to the pig and the donkey, which have a decidedly German look. The snout of the sow, which occupies the two-thirds of the breadth and one-third of the height of this large drawing, is an enormous projection with a more enormous termination. In the middle of the picture is a better bred pig, with a respectable tapering snout, and a nice convex back that would fit him for the company of the respectable porcine members for Berkshire or Hampshire. The right-hand corner again is occupied with an animal we suppose intended to represent a youthful pig, but its exceedingly long legs give it more the appearance of a calf. The donkey, too, has very high legs, and an enormously wide mouth. In fact, the head would be discountenanced by any respectable donkey. Young Hans, while leading his asinine friend to an adjacent thistle, is duly attending to the directions of Hans senior, before whom a smaller donkey stands much too heavily laden. The deer seem to us much more like our denizens of Windsor and other forest-parks, being, with the exception of an unnaturally long hind-leg on the leading character, boldly drawn, well coloured, and with capital umbrageous background, of which the lower part of the trunk of a noble tree is relieved by a graceful mass

of undergrowing foliage. Some of these German artists might do well in studying Harrison Weir. The drawings are beautifully coloured and highly effective.

Mechanical Industries Explained. By Alexander Watt. Edinburgh and London: W. and A. K. Johnston.

This book will be very useful to the general reader in stimulating inquiry and enlisting interest in various mechanical pursuits, some of which verge on the work of drawing-room ornament which ladies often perform with skill and taste. Nothing is more needful as a supplement to the book part of education than some employment involving physical effort for leisure time. This may often be termed a hobby, but every one ought to have some hobby, even if it be that of lock-making, pursued by Louis XVI. of France, or that of clock-making carried on by the Emperor Charles V. Music and drawing were formerly regarded as mere amusements for leisure, but have now become a serious business from whose study relaxation is required. This relaxation will be abundantly gratified by the details of Mr. Watt's interesting book, in which we are taught the light dexterities of gold-leaf ornaments and the making of rustic flower vases, to the heavy labour of brick making and bronze-casting. Of course a selection must be made in regard to mechanical operations, and for the leisure hours of most people the lighter kind that may be carried on indoors may be said to be generally preferable. Of these, the book before us contains clear instructions on papier-maché, crayons, etching, carving Irish bog-oak, lithographic drawing, the process of French polishing, and several occupations that may be carried on indoors. We too often find leisure time on the part of women restricted to a few operations connected with needlework or its less useful associates—crochet, wool-work, and the like—each of which have a 'run,' and are then thrown aside. The time that has been in most cases wasted on the making of those useless things called antimacassars would have been infinitely better employed in the old-fashioned work of knitting gloves or stockings. But in the book before us a variety of tastes can be gratified, the intelligence exercised, and articles of utility and taste produced. No objection ought to be urged against this book that it contains descriptions of important manufactures. If read it can scarcely fail of improving every household.

Geographical Reader: England and Wales. By J. M. D. Meiklejohn. Edinburgh and London: W. and R. Chambers.

This book forms the third of Messrs. Chambers' Geographical Reading Books, and is quite up to the average of most books on the same subject. It combines a fair amount of explanation, with a regular sequential statement of facts and descriptive outlines. For reading lessons on geography we should prefer more discursive explanations, and leave the regular topographical details to the usual text-books; but we must take what the gods—or rather, the publishers—give us. Messrs. Chambers have done their part well in an abundance of maps, several of which are worthy of particular notice in being novel, clear, and of great use in aiding the understanding of the text. The growth of London, for example, is shown to the eye by a map differently shaded from a central small black patch representing the London of 1600; this is encompassed by a shaded portion showing the extent of the metropolis in the middle of the last century; and this again by a less darkly shaded map indicating London of the middle of the present century; while the London of our days is shown by a lightly shaded map extending from Woolwich on the east to Brentford on the west, and beyond Brixton on the south to Stoke Newington on the north. Maps of the coal-fields, of the woollen and cotton districts, also of groups of counties, are equally clear and useful. So also is the map (page 104) showing the main lines of railway that converge on London, whereas the map of England (page 109), showing the railways, puts us in mind of a skeleton leaf, with its network of lines—most likely correct enough, but of which the eye gathers nothing but the impression of an intricate mass of lines. Mr. Meiklejohn has given a fair outline also of the principal social features of the English, and their prevalent industries. A little sketch is given of the traces of history in English place-names—an interesting topic, and one that is justly receiving increased attention in modern books on geography. This chapter is less accurate than might be expected from the ability that marks most other portions. The following is vague: 'The names of places in England are Roman, that is to say, Latin; Celtic, called in England Welsh; Teutonic, in other words English; and Scandinavian or Danish.' Most scholars would quarrel with all these asserted synonyms. Mr. Meiklejohn also explains *Watling Street* as the *Street of the Pilgrims* (*vadla*). Again, we have *Islington* explained as *the Town of the Little Sons of Isa* (which was a man's name among our ancestors) and *Newington*, the *Town of the Sons of New*. All this will be new to many who are aware that *ing* is an Old English termination for meadow, as well as for *son*, and in the former sense we have *Worthing*, *Goring*, *Lancing*, *Angmering*, and many other low lying meads stretching from the foot of the South Downs to the sea-board. *Newington* we should take to be a new town or place (as we call a collection of dwellings) on a piece of meadow land. *Islington*, doubtless, received its name from its mineral waters. We should conclude that Mr. Meiklejohn had not travelled much south of the Tweed from his calling Ely, with its streets of cobbled stones, a fine cathedral city. Dover, said to be 'the largest town in the county (of Kent),' is less populous than Gravesend, Greenwich, and some other Kentish towns. 'Kew and Richmond,' we are told, 'are two pretty towns on the Thames, each with a royal palace.' The little village of Kew must feel itself highly honoured at being raised to the dignity of a *town;* and the palace of Richmond, long ago demolished, now comprises a mere vestige of a bit of an old wall. Greater accuracy is needful also than to speak of the *North Downs* as crossing Sussex. Again, we are surprised to learn that Runnymede, adjacent to Egham and Staines, is 'not far from Kingston'—a distance of about ten miles is hardly to be thus described. Neither should we speak of Surrey as one of the hop-growing counties, as its only hop-gardens are on the Hampshire end of Farnham. We fancy also that the people of Essex will demur to the statement that richness of soil being by implication limited to its western parts. These in reality are more hilly and less rich in alluvial deposits than the eastern. But the entire county is fertile. Our ideas of geographical reading books are for the prevalence of explanatory remarks above a bare enumeration of facts and names. These latter, when given, should be accurate, and the most salient points given by way of description. Much is to be done to explain why certain industries are carried on in certain localities, together with the history, rise, and changes of such specialities. These are topics to be read about, and reasoned upon, as well as those more closely connected with physical geography. Mr. Meiklejohn has in this book done a little in the way we suggest. We wish he had done more.

Science Manuals: Sound, Light, and Heat. By Alfonzo Gardiner. Manchester and London: Heywood.

We have no fault to find with this book except in regard to the paper on which it is printed. This defect is almost painfully apparent on many pages, owing to the diagrams being drawn on blocks with a black ground. In all other respects the book is entitled to great praise. Its descriptions are clear and succinct, with the addition, where needful, of equally lucid explanations. Words are also, where necessary, etymologically traced, and in several cases clear arithmetical workings are given of

important test questions. After carefully mastering the contents of this little manual, the student is shown how best to prepare for the crucial test of filling-up an examination paper by a series of *home exercises*, in which the proper work of memory is shown, and the most suitable questions given to be correctly and neatly written. These, if properly examined by the teacher, will almost annihilate the chances of failure. A series of questions is appended comprising the examination papers of the Science and Art Department from 1872 to the present year. For fuller information the student is referred to the best modern treatises on the respective subjects named. But to all students we would say *master this book first.*

A Method of Teaching the Deaf to Speak. By Thomas Arnold. London: Smith, Elder and Co.

Cold must be the heart, and dull the mind, of any one failing to sympathize with Mr. Arnold's purpose and efforts. The deaf, he tells us, if left shut out from the intelligences opened by the exercise of speech, 'is immured in the merest animalism. You [the teacher] are to open his prison doors, and bring him forth to think and speak, that the light, and life, and liberty of the sons of God may be his also. Never count the cost. It may wear you and weary you, but it will bring you into closer fellowship with Him who opened the eyes of the blind, and unstopped the ears of the deaf.' These are noble words, and should animate all in the discharge of duty, but are doubtless more than usually needful to sustain and encourage the efforts of those who try to teach the deaf to speak. Mr. Arnold speaks with the authority of experience, having laboured for upwards of twenty years in the education of the deaf, and with such success that one of his pupils, Mr. Farrar (who began *de novo* at the age of three years, being then absolutely deaf and dumb), after passing the Cambridge Local Examination, matriculated last January in the London University. Mr. Arnold enters thoroughly into the history of the efforts that have been made in this field of philanthropic labour, from St. John of Beverley—whose so-called miraculous cure is capable of being explained as being largely connected with the skill connected with the process of imitation—to the philosophic Cardan, the more practical Abbé de l'Eppée, and so on down to the modern labours of Hill, Braidwood, Dr. Watson, and the congress held in 1880 at Milan, over which the Abbé Giulio Tarra presided. Ample details are given of the complexities of articulation, and the variety of sounds to be uttered, but the explanations appear to be so lucid, philosophical, and practical, that all who resolutely set to work may, by the aid of Mr. Arnold's book, be certain of success. Of course, much has to be done from the first steps of developing the utterance of sounds more plainly perceptible by lip-signs, such as *papa*, *vile*, and others beginning with p, b, f, or v. But these, when connected with written signs, and, when necessary, with other illustrations, as, for example, that on Prepositions, page 129, become the valuable foundations on which the superstructure of further progress depends. Mr. Arnold has spared no pains in producing an excellent book, which will be indispensable to every teacher of the deaf. The paper, printing, and illustrations are excellent, and we may add also the strong and thoroughly good binding, which will stand much wear and tear while preserving its comeliness. The price of such a book must needs be somewhat high, but the cost of a few extra shillings vanishes before the great importance of the book to those who need its aid. It must be considered as the standard book on tho subject, and is in every respect well worthy of this position.

Ward and Lock's Universal Instructor. Part 13.

This excellent serial still keeps up to the high standard of the earlier numbers.

Gill's Physical Exercises, with Musical Accompaniments. By R. H. McCartney. London: Gill and Sons, Warwick Lane.

Soldiers march better to the playing of a band than without, and the schoolboys' fife and drum bands greatly aid in developing regularity and precision in marching, in sustaining attention, and also in relieving the feeling of weariness attendant on physical effort. The same beneficial results will doubtless be connected with the use of music in the system of physical exercises known as 'drill.' These exercises often become tedious from an absurd habit many drill-masters have of making long pauses—probably with the idea of giving rest, but, generally speaking, with an opposite effect—between the movements. The unceasing progress of the swing of the music will greatly check this delay, and keep all 'going' without prolonged pauses. In Mr. Gill's book the exercises are well developed, and accompanied with good and abundant illustrations, together with all needful explanations and directions. Mr. McCartney's idea is good in regard to the music and the suitable collection of airs, mostly martial or suitable to marching movements. But they are arranged beyond the powers of any but good players. If the melodies given had been very much more easily arranged, they would have served the object better, by enabling even pupil teachers to play them. There is scarcely a bar in the present collection that is not marked by a change of the bass chords at every beat. This continued extension work for the bass hand places the music out of the reach of most amateurs. As musical exercises the arrangements and harmonies are unobjectionable, but this is not the main design of the book. The melody from Meyerbeer, No. 13, involving a continued sequence of triplets, is also less suitable for marching than such melodies as Nos. 5 and 15, marches from Bellini's operas, and also No. 1, from Verdi. Even these operatic airs, good as they are, might be advantageously mixed with a few of the ever-taking melodies of the Yankee Doodle and Tommy Dodd school; or, if foreign music must be had, let it be such as the capital march movement of 'Le Petit Tambour,' which Hickson, the first writer of English school songs, so admirably adapted to the words, 'Come, let us march and sing.' We doubt not but the systematic exercises of this book will be highly valued.

MESSRS. T. NELSON AND SONS' PRIZE BOOKS.

Beyond the Himalayas. A Story of Travel and Adventure in the Wilds of Thibet. By John Geddie. London: T. Nelson and Sons, Paternoster Row.

Mr. Geddie says, in the preface to this very interesting and ably-written book, that the problem of opening up an overland route from the Ganges to the Yang-tze ought to have some attraction for the imagination of young people, if they take as much delight in travel and adventure as they are generally supposed to do. He has therefore given us in his present volume an account of the supposed travels of a party of friends who passed through the wild mountain fastnesses and wide table-lands of Thibet, and has made his narrative as accurate as the diligent study of the best authorities will enable it to be. We venture to say that the boy who is fortunate enough to possess a copy of this book will not only be interested, but that he will acquire a large amount of very useful geographical and scientific knowledge. He will learn a great deal about the almost unknown land which lies beyond the wall of China—a land said to be wrapped in mental and spiritual darkness. The book is extremely entertaining, and is embellished with capital woodcuts. The binding is rich and pleasing in colour, and we can give the book no higher praise than to say that it is as instructive as it is amusing.

The Rocket; or, the Story of the Stephensons —Father and Son. By H. C. Knight. London: T. Nelson and Sons, Paternoster Row.

We hail the appearance of a new edition of this really admirable little book with pleasure. Years ago, when very young indeed, we read Mr. Knight's graphic account of George Stephenson's early labours, and how they brought him to riches and honour. No better book for inculcating principles of perseverance and honesty than this could be found, and we earnestly recommend all persons who have boys under their care to make them a present of it. The edition before us contains an additional chapter, in which the author speaks of the recent Stephenson Centenary, and of the development of the great work originated by the man who was once a poor lad. The book is well printed and bound, and the text is illustrated by no less than twenty-six engravings.

The Search for Franklin. A Narrative of the American Expedition under Lieutenant Schwatka. London: T. Nelson and Sons, Paternoster Row.

This little book gives us, in a neat and compact form, many interesting details of the search for Sir John Franklin conducted by Lieutenant Schwatka. It is furnished with excellent maps and illustrations, and will be prized by all boys who love adventure and maritime enterprise. While reading the account given here of the many attempts to discover the North-West Passage, we are strongly reminded of the lines of Mr. Tennyson which so well epitomise the spirits of discovery and boldness:—

'The bodies and the bones of those
That strove in other days to pass,
Are withered in the thorny close,
Or scattered blanching on the grass.
He gazes on the silent dead:
"They perished in their daring deeds,"
This proverb flashes through his head,
"*The many fail: the one succeeds.*"'

We suppose that the checks which our great Arctic explorers have experienced will only serve as an incentive to others to go forth to do battle with the ice and snow. The book before us will fire many a boy with enthusiasm; and, for anything we know, it may directly influence the one who is to succeed where the many have failed.

Tempered Steel; or, Tried in the Fire. By Rev. E. N. Hoare, M.A. London: T. Nelson and Sons, Paternoster Row.

Edward Ridley, the hero of this story, is of a type which is not unfrequently met with. He is a lad of good resolutions, amiable, kind-hearted, and manly, but easily led away by his companion, Ronald Cremer, a young man of extravagant and *gauche* habits. Mr. Hoare's little book is calculated to do good, and we commend it to the notice of parents and guardians.

Great Heights gained by Steady Efforts; or, Perseverance and Faithfulness Triumphant. By Rev. T. P. Wilson, M.A. London: T. Nelson and Sons, Paternoster Row.

Mr. Wilson's well-printed and strongly-bound volume is intended to convey a salutary lesson to young people. The story is very interesting and clear, and the 'get-up of the work renders it a most desirable reward or gift-book.

Alpine Climbing. By the Author of 'The Arctic World.' London: T. Nelson and Sons, Paternoster Row.

We have in this little work some very trustworthy narratives of recent ascents of Mont Blanc, the Matterhorn, the Jungfrau, and other lofty summits of the Alps. The ascents made by Professor Tyndall, Mr. Leslie Stephen, Mr. Alfred Wills, and other well-known mountaineers, are here graphically described; and there is a full account of that dreadful accident which happened on the Matterhorn in July, 1865, by which Lord Francis Douglas and his two companions lost their lives. Having resided in a mountainous district, we are naturally pleased with this book, and would fain linger over its pages. We are sure that it will encourage a love of travelling in many, and will tempt people to visit Switzerland with a view to ascending the 'Monarch of mountains'—Mont Blanc. The printing and binding are faultless, and there are thirty-four capital illustrations.

Stories about Dogs. By Mrs. Surr. London: T. Nelson and Sons, Paternoster Row.

In every way this is a delightful book. The choice of title is so good that no words of ours are needed to describe the contents. We will only say that the literary work, the illustrations (which, by the way, are from Mr. Harrison Weir's pencil), the printing, the binding, and the paper are alike excellent. Mrs. Surr's charming volume has our heartiest praise.

MESSRS. GRIFFITH AND FARRAN'S PRIZE BOOKS.

William Tell, the Patriot of Switzerland. By Florian. London: Griffith and Farran, St. Paul's Churchyard.

The anonymous writer of this book has sketched out a good trustworthy history of the Swiss patriot, which will be read with interest by children. We could wish, however, that the opening sentences of the first chapter had been written in a little less declamatory style. The printing is well done, and the binding exceptionally pretty.

Good in Everything; or, The Early History of Gilbert Harland. By Mrs. Barwell. London: Griffith and Farran, St. Paul's Churchyard.

Mrs. Barwell has here given us a pleasant little book, the object of which is to make children see 'good in everything.' She draws many useful lessons from animate and inanimate objects, and specially dwells on the necessity of being kind to animals. We are very glad to observe that this book, like the last, is printed in a type which will not harm the eyes of the little people for whom it is intended. The binding is neat and durable.

Hurricane Hurry; or, The Adventures of a Naval Officer Afloat and on Shore. By W. H. G. Kingston. London: Griffith and Farran, St. Paul's Churchyard.

The late Mr. Kingston's works are so well known that it is superfluous to praise them. They are healthy in tone, exciting, and eminently calculated to influence boys for good. 'Hurricane Hurry,' now in its eighth thousand, is full of good qualities. We feel sure that any boy will be proud to own this excellent tale.

Our Little Ones. Volume I. London: Griffith and Farran.

From our remarks in another column our readers will be able to form a pretty accurate idea of the merits of this volume. It makes a first-rate gift-book. Our own little ones have spent happy evenings looking at its clever pictures, and listening to its well-written stories.

We Four. By Mrs. Reginald Bray. London: Griffith and Farran.

We should not like our children to read this book, though we entertain no doubt of the good intentions of the authoress. But it comprises the youthful career of a young girl who is left motherless at the early age of four, and who tells her own tale of being the leading spirit of impetuous, wilful, thoughtless, and often spiteful and dangerous mischief. A moral is supposed to be drawn from little Cecil's confessions of carelessness and love of practical jokes; but we fear that the sympathies of youthful readers will be too much attracted to the fun of the tricks, and the moral be skipped or little heeded.

Query Column.

☞ As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'

RULES.

1. Each correspondent is restricted to *one question.*

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. Replies will not be sent through the post.

4. Correspondents are requested to write *legibly*, and on one side of the paper only.

5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.

6. Queries must reach the office *not la'er than the 15th oj the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed

'*The Query Editor,*'
The Practical Teacher,
Pilgrim Street, Ludgate Hill,
London, E.C.

1. X. Y. Z., Netteswell.—A can do a piece of work in 10 days which B can do in 8: after A has been at work upon it 3 days, B comes to help him; in what time will they finish it?

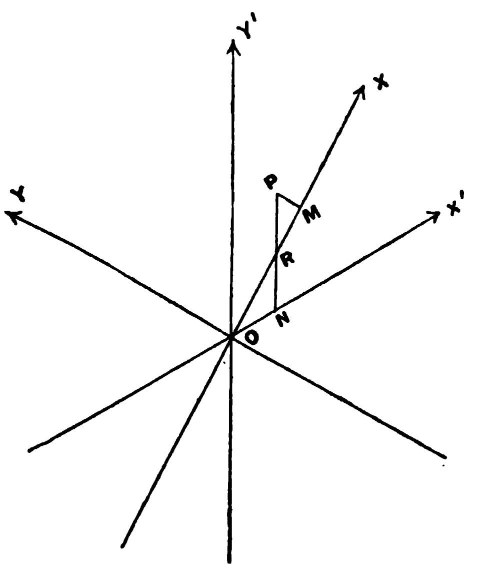
It is not all necessary to use Algebra.

A does $\frac{1}{10}$ of work per day.
B „ $\frac{1}{8}$ „ „
In three days A has done $\frac{3}{10}$
∴ there are $\frac{7}{10}$ths left
A and B together do $\frac{1}{8}+\frac{1}{10}$ per day
i.e. $\frac{9}{40}$ per day
∴ they will do the work in $\frac{40}{9}$ days

∴ they will do $\frac{7}{10}$ths of it in $\frac{7}{10}\times\frac{40}{9}=\frac{28}{9}$ days $=3\frac{1}{9}$. The days are of course reckoned from their becoming partners.

2. P.P., Bromley.—If (x, y) (x', y') be the co-ordinates of a point referred to rectangular and oblique systems with the same origin, and if the axes of the first system bisect the angles between those of the second, then

$$x = (x'+y')\cos\frac{\omega}{2}$$
$$y = (x'-y')\sin\frac{\omega}{2}$$



In the diagram the arrowheads mark, as usual, the positive directions of the axes

$$x'Oy' = \omega \;\therefore\; xOy' = \frac{\omega}{2}$$

Let P be any point PM $= y$ OM $= x$ PN $= y'$ ON $= x'$
Then OM = PN cos PRM + ON cos RON

$\therefore x = (PN + ON)\cos RON$, (for PRM = NRO = RO$y'$ = RON)

$$= (x'+y')\cos\frac{\omega}{2}$$
$$y = PM = PR\sin RON$$
$$= (PN - NR)\sin\frac{\omega}{2}$$
$$= (y'-x')\sin\frac{\omega}{2}$$

There is a sign wrong in your formula.

3. T. WILLIAMS, Oswestry.—I bought 100 cards for 9s, 2d., and sold the lot so as to gain $\frac{3}{8}$ of the selling price. Find the selling price and my gain per cent.

Suppose the selling price was 16s., the gain is $\frac{3}{8}$ of selling, or 6s.

∴ buying price is 16s. − 6s. or 10s.
but the buying price is actually 9s. 2d. $= 9\frac{1}{6}$s.
Hence as 10 : $9\frac{1}{6}$ :: 16 : selling price.
∴ selling price $=\frac{44}{3}=$ 14s. 8d.
Gain is 5s. 6d.
∴ Gain on $9\frac{1}{6}$ is $5\frac{1}{2}$
on $\frac{55}{6}$ is $\frac{11}{2}$
on 10 is 6
on 100 is 60

Answer 60%.

4. ENQUIRER, Saint Clears.—How high must a person be elevated above the earth's surface, so that he may view one-half of the whole world?

Considerably beyond the Pole Star, for he would never be high enough.

The general investigation is the same for a circle as for a sphere. Suppose we have a circle with centre C, and an observer stationed at P outside the circle. Let PA, PB be the tangents to the circle from P, and let PC meet the circle in D. Then the extent of the circle viewed by the observer is ADB. To find this, let PD $= h$ {the height above earth}. CD = CA = CB $= r$ {the radius of earth}

Then $\cos DCA = \frac{r}{r+h}$

$\therefore DCA = \cos^{-1}\frac{r}{r+h}$ $\quad\therefore BCA = 2\cos^{-}\frac{r}{+h}$

$\therefore$ at the height h the observer sees the following fraction of the earth's surface—

$$\frac{2\cos^{-1}\dfrac{r}{r+h}}{2\pi} \text{ or } \frac{\cos^{-1}\dfrac{r}{r+h}}{\pi}$$

If this is $\frac{1}{2}$ $\quad \cos^{-1}\dfrac{r}{r+h} = \dfrac{\pi}{2}$

$$\therefore \frac{r}{r+h} = \cos\frac{\pi}{2} = 0$$

This involves either that r should vanish, or that $r + h$ should become infinite. But r is always finite; $\therefore$ h is infinite, or the observer must be infinitely removed before this can happen.

5. NIGER, Retford.—Multiply 1t7 by 2t6 in the duodenary scale, and prove the answer by reducing multiplier, etc., to denary scale.

Any ordinary *Algebra*, Todhunter or H. Smith, would suit.

10 | 1 t 7
10 | 2 3. 1
2, 7
Ans. 271.

10 | 2 t 6
10 | 3 5. 4
4. 1 Ans. 414.

271 × 414 in denary, scale = 112194

1 t 7
2 t 6
e 3 6
169 t
392
10 | 54 e 16
10 | 65 t e 4
10 | 795 9
10 | 94 1
e 2 Ans. 112194.

6. CHARLES MORGAN, Cardiff.—The diameter of a circle inscribed in a right-angled triangle is equal to the excess of the base, and perpendicular above the hypotenuse.

You do not say by what method you wish this to be done, so we choose our own.

If a, b, c be sides of right-angled triangle—s the semi-perimeter, Δ the area, r the radius—

$$2r = \frac{2\Delta}{s} = \frac{2ab}{a+b+c} = \frac{a^2+b^2+2ab-c^2}{a+b+c} \text{ for } c^2 = a^2+b^2$$
$$= \frac{(a+b)^2-c^2}{a+b+c} = (a+b-c)$$
$$= a+b-c$$

7. T. GRINDLE, Salford.—Unfortunately, to answer your question would involve a criticism upon an article which has appeared in the PRACTICAL TEACHER. This is a thing we most studiously avoid.

8. EPSILON, Leamington.—We cannot help you. There are some 300,000 medical terms, and we must with sorrow confess that we are not conversant with them all. We can suggest one solution, however, that as the phrase occurred in a daily paper's scientific leading article, if it were analysed it would be found to have no meaning at all. This is usually the case. Of course the general sense of the passage you quote is clear. Vaccine is originally taken from cows during cow-pox. After a human being has been inoculated with this fresh vaccine, the lymph which occurs in the consequent eruptions is found to have all the properties of fresh vaccine, but not in so great strength. The meaning then is that after the lymph has been passed through several bodies it is no longer a certain preventive of smallpox; in fact, it is in great measure now useless.

9. JE NE SAIS PAS, LEES.—We have previously in the *Q. C.* recommended M. Chardenal's books for your wants.

10. PUZZLED, Doncaster.—Solve the equations—

$$\alpha.\ \frac{1}{y+\sqrt{2-y^2}} + \frac{1}{y-\sqrt{2-y^2}} = \frac{y}{3}$$

$$\beta.\ y^2+y+1 = \frac{42}{y^2+y}$$

α. We have

$$\frac{2y}{\{y+\sqrt{2-y^2}\}\{y-\sqrt{2-y^2}\}} = \frac{y}{3}$$

$$\text{or } \frac{2y}{y^2-(2-y^2)} = \frac{y}{3}$$

$\therefore$ $y=0$ is one root and the others are given by

$$2y^2-2 = 6 \text{ or } y = \pm 2$$

β. Let $y^2+y = x$, then

$$x(x+1) = 42$$
$$x^2+x-42 = 0$$
$$(x+7)(x-6) = 0$$
$$y^2+y+7 = 0 \quad y = \frac{-1\pm\sqrt{-27}}{2}$$
$$y^2+y-6 = 0 \quad y = -3 \text{ or } 2$$

11. B. G., Gosport.—You would save us a good deal of trouble if, instead of sending us your lines to analyse, you would just point out where your difficulties are. We confess we fail to see them. Analyses of sentences take up so much room in proportion to their value, and we rarely attempt such in the *Q. C.* Our objection is that the subject is, as a rule, very easy, and just where the difficulties come in, every authority you can meet with has a different opinion. Mention some of your difficulties to us next number.

12. SPHINX, Cornwall.—You treat us in a remarkable fashion. Suppose, for the nonce, that we change places. You be Query Editor, we 'yours faithfully.' How would you feel if we sent you Todhunter's larger *Algebra*, with the remark that there were a good many examples in it that we had been fairly floored by, and the polite request, would the Query Editor be so kind as to work the book through, say five a month, and 'keep this communication, as it will save me the trouble of writing every month?'

You must write every time if you want an answer.

The image of an object is distant 8 inches from a convex lens of focal length 12 inches, find the distance of the object.

$$\text{Formula is } \frac{1}{D} - \frac{1}{d} = \frac{1}{f}$$
$$\text{or } \frac{1}{8} - \frac{1}{d} = \frac{1}{12}$$
$$\text{or } \frac{1}{d} = \frac{1}{8} - \frac{1}{12}$$
$$= \tfrac{1}{24}$$
$$\therefore d = 24$$

13. DOUBLE GLOSTER, Cam.—

(α) In what time will £400 amount to £467 18s. 10·42d. at 4 per cent. comp. int.?

(β) At what rate per cent. will 70 guineas amount to £114 16s. 10½d. in 2 years at comp. int.?

There is strictly no arithmetical method of doing a sum like this. As a guide to the course we shall pursue, take £a at r per cent. for n years. For 1 year we multiply by r and divide by 100;

$$\therefore \text{Interest for 1 year} = \frac{ar}{100}$$

$$\therefore \text{Amount after 1 ,,} = a + \frac{ar}{100} = a\left(1+\frac{r}{100}\right)$$

$$= \text{Original amount} \times \left(1+\frac{r}{100}\right)$$

$\therefore$ Amount after second year

$$= \text{first amount} \times \left(1+\frac{r}{100}\right)$$

$$= \text{original} \times \left(1+\frac{r}{100}\right)^2$$

etc.

Hence after n years, if M be the amount,

$$M = a\left(1+\frac{r}{100}\right)^n$$

If M and a be given, also r and n be required, taking logarithms

$$n \log\left(1+\frac{r}{100}\right) = \log M - \log a$$

$$\therefore n = \frac{\log M - \log a}{\log(100+r)-2}$$

If, however, n be given, and r be required, we can always do it by Arithmetic, for

$$1+\frac{r}{100} = \left(\frac{M}{a}\right)^{\frac{1}{n}} \text{ and this can always be found.}$$

Thus in your second sum

$$n=2 \quad M = £114\ 16s.\ 10\tfrac{1}{2}d.$$
$$a = £73\ 10s.\ 0d.$$
$$\frac{M}{a} = \frac{114{\cdot}84375}{73{\cdot}5} = 1{\cdot}5625$$
$$\therefore\ 1 + \frac{r}{100} = \sqrt[2]{1{\cdot}5025} = 1{\cdot}25$$
$$\therefore\ r = 25$$

In the first example we have two choices open, either to find an approximate result by trial, which is a very pitiable process, though it would necessarily be successful if n were integral, or to take logarithms. Adopting the latter course

$$M = £467\ 18s.\ 10{\cdot}42d.$$
$$= £467{\cdot}943417 \text{ (nearly.)}$$
$$a = £400, \quad 100+r=104$$
$$\text{Hence} \quad \frac{\log M - \log a}{\log (100+r) - 2}$$
$$= \frac{2{\cdot}6701935 - 2{\cdot}6020600}{0170333393}$$
$$= \frac{{\cdot}0681335}{{\cdot}0170333393}$$

17·0333393)68·1335000(4·000008
                     68 1333572
                         1428000000

Ans. 4·000008 % or 4%.

There are one or two noticeable points about a sum of this sort. In the first place, our answer is inexact by *eight millionths* per cent. It is the very rare exception for the method of logarithms to bring answers quite exact. Also in finding the value of n we took numerator logarithms to 7 places, denominator to 10. This last is a general principle founded on obvious rules. It is worth noticing for its own sake.

14. J. R. B., Leominster.—A grocer bought two lots of tea; for one lot he gave 6s. per lb.; and for the other 4s. per lb. In what proportions must he mix them so as to be able to sell the mixture for 5s. 3d. per lb., and gain 20 per cent. on outlay.

Selling price 5s. 3d. gain 20%
$\therefore$ Selling value is $\frac{5}{6} \times$ 5s. 3d. = 4s. $4\frac{1}{2}$d.
Thus 8 lbs. of mixture are worth 35s.
Hence $6 \times$ No. of lbs. of first quality
$+\ 4 \times$ No. of second quality = 35s.
for first quality costs 6s. per lb.
Also No. of lbs. of 1st + No. of 2nd = 8
$\therefore$ $6 \times$ No. of lbs of 1st + $6 \times$ No. of 2nd = 48
$\therefore$ $2 \times$ No. of 2nd = 13
$\therefore$ there are $6\frac{1}{2}$ lbs. of 2nd quality
and $1\frac{1}{2}$ lbs. of 1st quality.

15. F. S., Romford.—If n be a whole number, what is the least value of n for which $(\frac{2}{3})^n < \frac{1}{8}$.

The only arithmetical way is to take n equal to all the integers in succession

$n = 1$	$(\frac{2}{3})^n \times 8$	$\frac{16}{3}$
$n = 2$	"	$\frac{32}{9}$
$n = 3$		$\frac{64}{27}$
$n = 4$		$\frac{128}{81}$
$n = 5$		$\frac{256}{243}$
$n = 6$		$\frac{512}{729}$ and this is less than one.

Of course, to get these fractions multiply the numerator of each by 2, and the denominator by 3. If n were not an integer this course would fail. In this case we must use logarithms: let us find the values of n for which $(\frac{2}{3})^n = \frac{1}{8}$

$$n\,\{\log 2 - \log 3\} = -\log 8$$
$$\therefore\ n = \frac{\log 8}{\log 1{\cdot}5}$$
$$\frac{{\cdot}9030900}{{\cdot}1760913}$$

To find this expeditiously take logarithms again.

$$\therefore\ \log n = \log 90309 - \log (17609{\cdot}13)$$
$$= {\cdot}9557310 - {\cdot}2457373$$
$$= {\cdot}7099937$$
$$n = 5{\cdot}1285375$$

This answer will be correct probably to the last decimal place. All values of n greater than this will make

$$(\tfrac{2}{3})^n < \tfrac{1}{8}.$$

16. A. L., Kensington.—If the equations $x \cos \alpha + y \sin \alpha = p$ $\frac{x}{a} + \frac{y}{b} = 1$ $Ax + By = C$ $y = nx + c$ represent the same line then

$$p = \frac{C}{(A^2+B^2)^{\frac{1}{2}}} = \frac{ab}{(a^2+b^2)^{\frac{1}{2}}} = \frac{c}{(1+n^2)^{\frac{1}{2}}}$$

p is the perpendicular from the origin on the line. Now by the ordinary formula, the perpendicular from (x, y) on the lines is

$$= \pm \frac{\frac{x}{a} + \frac{y}{b} - 1}{\sqrt{\frac{1}{a^2} + \frac{1}{b^2}}} = \pm \frac{Ax + By - C}{\sqrt{A^2 + B^2}}$$
$$= \pm \frac{y - nx - c}{\sqrt{1 + n^2}}$$

Hence p the perpendicular from origin

$$= \frac{1}{\sqrt{\frac{1}{a^2} + \frac{1}{b^2}}} = \frac{C}{\sqrt{A^2+B^2}} = \frac{c}{\sqrt{1+n^2}}$$
$$= \frac{ab}{\sqrt{A^2+b^2}}$$

the sign given to the radical being such as in all cases to make the perpendicular positive.

17. FEMINA, Bradley.—We believe marks are given for each branch of drawing. No list such as you want is published.

18.—ANGUIS, Bradley.—We recommend the following text-books for the Q. S. Examination:—*Arithmetic*, Mansford's (4s. 6d.); *History*, Curtis (large vol.); *Algebra*, Todhunter (7s. 6d.); *Mensuration*, Elliott's (2s.); *School Management*, Currie's (Stewart); *Music*, Sutton's.

12. PERMUTATION.—If you take the trouble to read our rules we shall be happy to oblige you with your problem next time.

20.—TOM, Horsham.—Try Abbott's two books on 'How to tell the Parts of Speech,' and 'How to Parse.'

21.—ENQUIRER, Cefn.—They appear in our present issue.

22.—L'ALLEGRO, Hasland.—A farm is let for £96 and the value of a certain number of quarters of wheat. When wheat is 38s. per quarter the whole rent is 15 per cent. lower than when it is 56s. a quarter. Find the number of quarters of wheat which are paid as part of the rent.

Let x be the number of quarters.

Then when wheat is 38s. whole rent is

$$£\left(96 + \frac{38}{20}x\right) = £\left(96 + \frac{19x}{10}\right)$$

When it is 56s. it is $£96 + \frac{56}{20}x$.

$$\therefore\ 96 + \frac{19x}{10} = \frac{85}{100}\left(96 + \frac{14}{5}x\right)$$
$$\text{or } \frac{96 \times 15}{100} = x\left(\frac{\overset{17}{\cancel{85}}}{100} \times \frac{14}{\cancel{5}} - \frac{19}{10}\right)$$
$$= x\left(\frac{238 - 100}{100}\right)$$
$$= x\tfrac{48}{100}$$
$$\therefore\ x = 2 \times 15 = 30.$$

It will not be hard for you to translate this into arithmetical language if you require it so.

23. GIVALIA, Pen-y-Cwm.—In a cricket match the scores in each successive innings are $\frac{1}{4}$ less than in the preceding innings; and the side which has the first innings wins by 50 runs. What are the scores in each innings?

Let us suppose the first score to be 320, the second is $\frac{3}{4}$ of 320, or 240; the third is $\frac{3}{4}$ of 240, or 180; the fourth is $\frac{3}{4}$ of 180, or 135.

$\therefore$ the first side scores altogether

$$320 + 180 = 500$$

and the second

$$240 + 135 = 375$$

$\therefore$ the first wins by 125.
But it actually wins by 50.
Hence

$$\text{first score} : 320 :: 50 : 125$$

$$\therefore \text{first score} = \frac{320 \times 50}{125} = 128.$$

24. H. G., Richmond.—One square is inscribed in another in such a position that the areas of the two are in the ratio of 16 to 25, the side of the larger square being 10. What is the distance of each corner of the inner square from each extremity of that side of the outer square on which it rests?

The areas are as 16 : 25.
$\therefore$ the sides are as 4 : 5.
$\therefore$ the sides are 8 and 10.
Let ABCD be the larger square,
and PQRS „ smaller „
P being between A and B.

Let $AP = x$, and $AB = 10$.

It can be easily proved by Elementary Geometry that

$$AP = BQ = CR = DS = x,$$
$$\text{and } PB = QC = RD = SA$$
$$= 10 - x.$$

But $PS^2 = SA^2 + AP^2$ (Euclid I., 47).
But $PS = 8$

$$\therefore 8^2 = (10 - x)^2 + x^2$$
$$= 2x^2 - 20x + 100$$
$$\therefore x^2 - 10x + 18 = 0$$
$$x^2 - 10x + 25 = 7$$
$$x = 5 \pm \sqrt{7}.$$

25. NORTH, Penrith.—If the sides of any triangle be bisected, prove that the lines drawn at right angles to the sides through the points of bisection meet in a point.

Let ABC be the triangle, E and D the middle points of AB and BC respectively, EO and DO perpendiculars to the sides at these points. EO and DO meet in a point for joining ED, we have DEO + EDO less than ODB + OEB, *i.e.*, less than 2 right angles. Hence, by Axiom, EO and DO intersect.

From O draw OF perpendicular to AC, we shall prove that F is the middle point of AC.

We have BD = DC, OD common, and angles ODB, ODC each equal to a right angle.

$\therefore$ by Euclid I., 4, OB = OC.
Similarly OB = OA.

Hence OA = OC,
But $OA^2 = OF^2 + FA^2$,
and $OC^2 = OF^2 + FC^2$, by Euclid I. 47.
$\therefore FA^2 = FC^2$.

26. SCHOOLMISTRESS, Hallsworth.—Eight bells begin tolling simultaneously, and they toll at intervals of 1, 2, 3, 4, 5, 6, 7, 8 seconds respectively; find after what interval of time they will again be all tolling at the same instant.

The rule in all such sums is to take the L.C.M. after reducing all the intervals to the same denomination. In this case no reduction is needed, and L.C.M. is 8 × 7 × 5 × 3, or 840 seconds, or 14 minutes. The reason of this will be seen at once by an example. Suppose the intervals were 3, 5, 6, the following table represents the tollings of each bell, the bells being represented by Roman numerals. The figures refer to the number of seconds after the commencement when the tollings took place, and a star indicates that a bell tolled in that second under which it is placed :—

	1	2	3	4	5	6	7	8	9	10	11
I.	*			*			*			*	
II.	*					*					*
III.	*						*				

	12	13	14	15	16	17	18	19	20	21	22
I.		*			*			*			*
II.					*					*	
III.		*						*			

	23	24	25	26	27	28	29	30	31
I.			*			*			*
II.				*					*
III.			*						*

Thus, the only rows in which there are three asterisks are 1 and 31, and there is between these an interval of 30, or 6 × 5, which is the L.C.M. of 3, 5, and 6.

The diagram would be very useful in explaining the same to children.

27. LIBRA, Lincoln.—The *Proceedings of the Royal Astronomical Society* is the only strictly astronomical publication we know of. It is very technical.

Nature, published monthly (6d., Macmillan), would probably suit you as well. Or try *The English Mechanic and World of Science* (weekly, 2d.).

28. NEMO, Escomb.—A lb. of tea and 3 lbs of sugar cost 6s.; but if sugar were to rise 50 per cent. and tea 10% they would cost 7s. Required price of tea and sugar.

The conditions are equivalent to

$$1 \text{ lb. tea} + 3 \text{ lbs. sugar} = 6 \text{ shillings}$$
$$\tfrac{11}{10} \text{ lb. tea} + \tfrac{3}{2} \times 3 \text{ lbs. sugar} = 7 \text{ shillings}$$
$$1 \text{ lb. tea} + \tfrac{45}{11} \text{ lbs. sugar} = \tfrac{70}{11} \text{ shillings}$$
$$\therefore \left(\tfrac{45}{11} - 3\right) \text{ lbs. sugar} = \tfrac{70}{11} - 6$$
$$\text{or } \tfrac{12}{11} \text{ lbs. sugar} = \tfrac{4}{11} \text{ shillings}$$

Sugar = 4d. and tea = 5s.

29. Y. P., Otley.—We do not know any separate edition. If there is one published there will not be more than one, and your bookseller will be able to get it for you. You will probably not obtain one with a vocabulary.

30. PUZZLED, Barnstaple.—If, as you say, you have done neither Latin nor French, we think it is folly of you to try and take them next July. Your time would be almost wasted. If you are determined, French is the easier, but you will almost certainly fail if you try to learn it altogether by yourself.

31. THETA, Market Drayton.—You should learn all Morris, but may omit the greater part of Anglo-Saxon lists at the end. You should however be thoroughly familiar with the main principles of A. S. Grammar.

Morris' and Skeat is one book.

32. S. M. S., Alfreton.—If 4 men with 7 women earn £5 9s. 0d. in a week, and 5 men with 2 women earn £4 9s. 0d. in the same time, in what time will 3 men and 3 women earn £6 6s. 0d.?

(The answer you quote is absurd).

4 men + 7 women earn 109 shillings
while 5 men + 2 women earn 89 „
Hence 8 men + 14 women earn 218 sh. per week
35 men + 14 women earn 623 sh. „ „
$\therefore$ 27 men earn 405 sh. „ „
$\therefore$ 1 man earns 15 sh. „ „
Hence 1 woman earns 7 sh. „ „
$\therefore$ 3 men + 3 women earn 65 sh. in a week
$\therefore$ they will earn 126 sh. in $\frac{126}{65}$ weeks or $1\frac{61}{65}$ weeks.

33. J. SAUNDERS, Bourton-on-the-Water.—We confess we do not see what you wish explaining. The general sense is surely clear.

34. A WELSH, P.T., Carnarvon.—We cannot suggest any improvement in your method. Surely you can draw lines with fair exactitude without a ruler, so that its prohibition cannot affect you much.

35. YELSERP, Southampton.—A company consists of 1 captain, 2 lieutenants, 6 sergeants, 10 corporals, 50 men, who storm a fort, finding a prize worth £1600, which is divided among

them according to their pay and time of service. The captain has been in service for 15 years, and is paid 11s. 7d. a day; the lieutenants have served $3\frac{1}{2}$ years, and are paid 6s. 6d. a day; the sergeants have served 7 years, and are paid 2s. 6d. a day; the corporals 4 years, and are paid 1s. 6d. a day; and the men 2 years, and are paid 1s. a day. What portion of the prize did each receive?

It will be seen at once, on reducing the payments to pence, that

Captain's share : that of the two lieutenants : that of the 6 sergeants : that of the 10 corporals : that of the 50 men
$.: 139 \times 15 : 2 \times 78 \times \frac{7}{2} : 6 \times 30 \times 7 : 10 \times 18 \times 4 : 50 \times 12 \times 2$
i.e. :: 695 : 182 : 420 : 240 : 400. Hence the captain receives

$$\frac{695}{695+182+420+240+400} \text{ of spoil or } \frac{695}{1937}.$$

Each lieutenant ...	...	$\frac{1}{2} \times \frac{182}{1937}$ or $\frac{91}{1937}$
Each sergeant ...	...	$\frac{1}{6} \times \frac{420}{1937}$ or $\frac{70}{1937}$
Each corporal ...	...	$\frac{1}{10} \times \frac{240}{1937}$ or $\frac{24}{1937}$
Each man...	...	$\frac{1}{50} \times \frac{400}{1937}$ or $\frac{8}{1937}$

These fractions multiplied by 1600 will give the answers in pounds; thus, if the spoil had been £1937, the division would have been £695, £91, £70, £24, £8.

He who likes tedious work can simplify these. The sum is ineffably dreary, besides being involved in an ambiguity which may bring it to pass that all our precious work is wrong.

36. ENQUIRER, Portsmouth.—100 acres are planted with barley one year and 75 the next year. Each year $\frac{1}{4}$ of the produce is of the best quality and $\frac{3}{4}$ of the remainder of medium quality, which sells at $\frac{2}{3}$ of the price of the best. The rest is inferior, and sells for $\frac{2}{3}$ of the price of the medium quality. The second year the yield per acre is $\frac{1}{2}$ as much again as before; and, the malt-tax having been abolished, the prize of the best barley falls 9s. 4d. per quarter; while that of the medium quality only falls 2s., and the inferior is unaltered in price. If the whole of the barley sells each year for the same total sum, find the prices of the different qualities.

In the second year the yield is $\frac{1}{2}$ as much again as before. Hence there is an equivalent to $\frac{3}{2}$ of 75 acres or $\frac{225}{2}$.

Hence first year we have the yield of 25 acres best quality—
$\frac{225}{4}$ acres medium, @ $\frac{2}{3}$ price of best.
$\frac{75}{4}$,, inferior, @ $\frac{4}{9}$,,

The second year we have—
$\frac{225}{8}$ best quality, @ former price — 9s. 4d.
$\frac{2025}{32}$ medium, @ $\frac{2}{3}$ best price — 2s.
$\frac{675}{32}$ inferior, @ $\frac{4}{9}$ best price,

Hence equating the gain through increase of quantity to the loss through the decrease of price.

$$\tfrac{225}{8} - 25 + \left(\tfrac{2025}{32} - \tfrac{225}{4}\right)\tfrac{2}{3} + \left(\tfrac{675}{32} - \tfrac{75}{4}\right)\tfrac{4}{9} \text{ bushels}$$

at the price of the best quality are equivalent to

$$9\tfrac{1}{3} \times \tfrac{225}{8} + \tfrac{2025}{32} \times 2 \text{ shillings,}$$

$$\text{or } \tfrac{25}{8} + \frac{\cancel{2}}{3} \cdot \frac{225}{\cancel{32}_{16}} + \frac{\cancel{4}}{\cancel{9}_{3}} \cdot \frac{\cancel{75}^{25}}{\cancel{32}_{8}} \text{ bushels.}$$

$$= \tfrac{28}{3} \times \tfrac{225}{8} + \tfrac{2025}{16} \text{ shillings,}$$

$$\text{or } \tfrac{1}{8} + \tfrac{3}{16} + \tfrac{1}{24} \text{ bushels} = \tfrac{21}{2} + \tfrac{81}{16} \text{ shillings,}$$

$$\text{or } \frac{6+9+2}{48} \text{ bushels} = \frac{168+81}{16}$$

$$\text{or } \tfrac{17}{48} \text{ bushels} = \tfrac{249}{16} \text{ shillings.}$$

$\therefore$ therefore 1 bush. cost $\frac{747}{17}$ shillings.
or 44 shillings nearly.
or £2 4s. nearly.

Hence the three qualities are at—

44s. per qr.
29s. 4d. per qr. } approximately.
19s. 6d. per qr.

37. EPILSON.—It is not your statement of the problem that is wrong; the original is so beautifully vague as to make half a dozen meanings possible. If it will do you any good to work it out under several different meanings, we are willing, but do not expect to get your answer. Cannot you see this? We are very sorry we are unable to help you.

38. G. LAMOTTE, Teynham.—Solve the equations,

$$x^2 = \frac{39}{y} - \frac{14}{x}$$

$$y^2 = \frac{42}{x} - \frac{13}{y}$$

As algebraical symbols are nearly always easier to deal with in complicated equations than numerical quantities, write the equations,

$$\left\{\begin{aligned} x^2 &= \frac{a}{x} + \frac{b}{y} \\ y^2 &= \frac{c}{x} + \frac{d}{y} \end{aligned}\right.$$

$$\text{Or } \quad x^3y = ay + bx$$
$$y^3x = cy + dx$$

Hence $y = \dfrac{bx}{x^3 - a}$ and substituting this value in the second,

$$b^3x^4 = bcx(x^3-a)^2 + dx\,(x^3-a)^3$$
$$\text{Or } \quad b^3x^3 = bc(x^3-a)^2 + d(x^3-a)^3$$
$$\text{Put } \quad x^3 = X$$
$$b^3X = bc(X-a)^2 + d\,(X-a)^3$$
$$\therefore \; dX^3 + X^2(bc-3ad) + X\,(3a^2d - 2abc - b^3) + a^2bc - a^3d = 0$$

Hence putting

$$3A_1 = \frac{bc - 3ad}{d}$$
$$3A_2 = \frac{3a^2d - 2abc - b^3}{d}$$
$$A_3 = \frac{a^2bc - a^3d}{d}$$

We have

$$X^3 + 3A_1X^2 + 3A_2X + A_3 = 0$$

Put $X = Y - A_1$ and let

$$3B_2 = 3A_1^2 - 6A_1^2 + 3A_2 = 3(A_2 - A_1^2)$$
$$B_3 = -A_1^3 + 3A_1^3 - 3A_1A_2 + A_3 = 2A_1^3 - 3A_1A_2 + A_3$$

and the equation becomes

$$Y^3 + 3B_2Y + B_3 = 0$$

Put $Y = w + z$ and $wz = -B_2$

and we get

$$w^3 + z^3 + B_3 = 0$$
$$\text{or } \quad w^3 - \frac{B_2^3}{w^3} + B_3 = 0$$
$$w^6 + B_3w^3 - B_2^3 = 0$$
$$\text{or } w = \omega \left\{\frac{-B_3 \pm \sqrt{B_3^2 + 4B_2^3}}{2}\right\}^{\frac{1}{3}} = \omega p \text{ (say)}$$

where ω is a cube root of unity.

Hence finally

$$x = \omega \left\{\omega p - \frac{B_2}{\omega p} - A_1\right\}^{\frac{1}{3}}$$

and therefore has nine values, since ω is capable of either one of the three values 1, $\dfrac{-1 \pm \sqrt{-3}}{2}$

The values of the terms B_2, etc., must be calculated in order to get X numerically.

Thus the general case is completely solved. Using the numerical values we can easily find position of roots.

It is scarcely worth while, however, to work it out in full. We will merely indicate the familiar method in Theory of Equations. Let $f(x)$ be the equation. Write down the series of signs of the expressions

$f(-\infty)$......... $f(-10)\,f(-9)$......... $f(-1)\,f(0)\,f(1)$......... $f(7)\,f(8)$......... $f(+\infty)$.

If any of these, say $f(a)$ vanishes, a is a root. If not, observe where the signs change. Thus, if $f(a)$ and $f(a+1)$ are of opposite signs, a root lies between a and $a+1$.

39. T. O. MUMMERY, Folkestone.—If from the extremities of any chord in a circle lines be drawn to any point in the diameter to which it is parallel, the sum of their squares is equal to the sum of the squares of the segments of the diameter.

Let AEB be the diameter, E being the centre; CFD be the chord, F being its middle point, C and A being on the same side of FE, K the point in the diameter AB being taken between A and E.

Then by an ordinary theorem (Todhunter's Euclid, Appendix i.),

$$CK^2 + KD^2 = 2KF^2 + 2CF^2$$
$$= 2KE^2 + 2EF^2 + 2CF^2$$
$$= 2KE^2 + 2AE^2$$
$$= AK^2 + KB^2. \quad \text{(Euc. II. 9.)}$$

40. W. R., Shetland.—In the base of a triangle to find a point from which if two lines be drawn (1) perpendicular (2) parallel to the two sides of the triangle their sum shall be equal to a given line.

Let ABC be the given triangle, base AC.

(1) Let O be the point required, and OM, ON the perpendiculars from O on the sides AB, BC respectively.

Then the sum of the rectangles AB.OM + BA.ON is equal to the rectangle contained by AB and the given line.

But the rectangles AB OM + BC ON equal twice the sum of areas of AOB and COB, *i. e.*, to twice the area of ABC.

∴ the difference of the rectangles ON.BC and ON.BA is equal to the difference between the rectangle contained by AB and the given line, and twice the area of ABC.

Now, by Euclid I. 45, make a rectangle equal to the area which represents the difference between these two, one of whose sides is the difference between BC and AB, then the other side is ON, and thus ON is known.

From the point C draw CD perpendicular to BC, D and A being on the same side as BC, and through D draw DO parallel to BC. DO will meet AC in O, the point required.

(2.) Suppose O the required point, PQ the given line; OM, ON the lines through O parallel to BC, AB respectively.

Then OM : AO = BC : AC (Euc. VI. 4),
or rectangle OM.AC = rect. AO.BO.
Also ON : OC = AB : AC
= rect. AB.AC − rect. AB.AO.
Or rect. ON.AC = rect. OC.AB

∴ by addition
Rect. contained by AC and P Q
= rect. AB.AC + rect. contained by
AO and diff. of BC and AB.

$$\text{or } PQ = AB + \frac{AO}{AC}(BC - AB)$$

$$\therefore AO = \frac{AC}{BC - AB}(PQ - AB.)$$

Wherefore take a fourth proportional AO to the three lines BC − AB, AC, and the difference between the given line and AB.

The distance AO being taken from A along AC, gives O the required point.

41. X. Y. Z., Mossley.—Draw a line DE parallel to the base BC of a triangle ABC, so that DE is equal to the difference of BD and CE.

Draw BF bisecting the angle ABC and CF bisecting the angle ACK, K being in BC produced. Let these meet in F, and draw FED parallel to BC, then FED is the line required.

For DBF = CBF = BFD
∴ BD = DF
Similarly CE = EF
∴ BD = DE + EC
∴ BD − EC = DE.

42 and 43.—QUERIES UNANSWERED.—The Query Editor has this month been unavoidably compelled to answer the whole of the queries at short notice, so that it will be quite excusable if the previous work is at all faulty. In consequence of this haste he has not been able to give to the two following problems the attention they require. He considers that they are worthy of the attention of the readers, as admitting of a variety of solutions, and accordingly offers them for general competition, and will be glad to insert a notice of any successful attempts:—

N. E. SANDERSON, Sheffield.—Given the four sides of a quadrilateral figure in order, and the angle between one pair of opposite sides, construct the figure. (*Science and Art*, 1881.)

A SUBSCRIBER, Nottingham.—ABC is any triangle. AD bisects the angle A, and AE is drawn to E, the middle point of BC; prove that AE > AD. (By Euclid I. 19, or previous propositions.)

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Health at School.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),

Vice-President of the British Medical Association.

X.—PHYSICAL EXERCISE.

THE narrow view of the function of the schoolmaster is well exemplified in some schools by the entire banishment of physical exercise from the rota of school work. We send our children to school for the purpose of training them for the battle of life, which they will have to encounter when they reach to man's estate. It is by the equal and continuous development of each and every part of the body that this battle will be fought with success, and if one part developes at the expense of another, or by its more rapid development puts a bar to the progress of the others, the subject of it is at disadvantage in his future struggles. Many a Cambridge wrangler and Oxford first-class man has found this out in after life. He is able to solve a problem in differential calculus, to make Latin verses, or to read a passage in any of the dead languages at sight, but he has not cultivated the talent of common sense, or educated his muscles so that they can enable him to leap over some slight impediment in his path. He finds himself outstripped in the daily race by men whom he has been taught to despise, and who, in return, have a very small opinion of him and his mental power. The nerve force of thought in his brain has been developed at the expense of his motor power, and as the room for growth is limited, the latter is dwarfed and imperfect. Life is 'organization in action,' and the various functional activities of the body must be carried out with normal energy and in a harmonious manner, if they are to be correct in their responses to any and every call that may be made upon them. Physical exercise is indispensable, and it is quite impossible for the functions of respiration and circulation to be carried on in a proper manner if the muscular system is not developed, and if the material which is necessary for the formation of the muscle is not used up in its proper order. If the muscles are not used equally with the brain tissue, some used up matter is kept back, and will sooner or later act as an impediment to proper brain work, by getting in the way of the latter when it requires all the room which ought to be at its command. The assimilative and disarranging processes of the body are greatly influenced by the activity or inactivity of the muscular system. Hence it follows that no school is properly constituted which does not provide an exercise ground for its pupils, and make the cultivation of muscular force a part of its daily routine. This is not the place to deal with the general effects of exercise, but it will not be out of order to call to mind the fact that, the natural heat of the body being 98·4, it follows that something must be produced in the blood, which is the *débris* of the continuous fire that is always burning, and by means of which the natural heat of the body is kept up to its proper standard. The principal product in this manufacture is carbonic acid (Co_2). The daily amount expired, as I have already shown, is very considerable; it is produced, in a great measure, *in situ* and must be removed from the body. The larger the quantity remaining in the tissues of the body, the more impure is the blood; and the smaller the quantity remaining behind, the nearer the blood is kept to its normal standard. Now it has been proved that taking the quantity expired during rest in the recumbent position as 1, or unity, there has been expired when a person is sitting, 1·18; standing, 1·33; walking one mile an hour, 1·9; walking two miles per hour, 2·76; walking three miles an hour, 3·2; riding on horseback, 4·; walking at four miles per hour, 4·; running at six miles per hour, 7·. Thus it is seen that the quantity excreted is increased seven times whilst running quickly, as compared with rest in the recumbent position. In connection with this elimination of Co_2, there must be a corresponding increase in the absorption of oxygen, and greater ability to maintain the animal heat at its normal standard, without requiring a warmer atmospheric air to live in. It will be easily understood by this one illustration how it is that exercise in the coldest air is accompanied by increased warmth. The union of the oxygen with the carbon, which is set free by the process of assimilation constantly going on in the body, and which union takes place in the muscular system more acutely than in any other part of the body, produces a warmth of a most decided character, and which production does not cease with the cessation of the exercise. The manufacture of warmth in this manner is very advantageous to children, and any complaining of cold should be persuaded to warm themselves by the com-

bustion of carbon in their own frames, rather than be encouraged to obtain it by warm rooms and hot bottles to the feet, blazing fires, or any other means than by producing warmth within themselves

There is also another aspect of the case; muscular tissue wastes during long-continued rest. Any person may find this out for himself if he notes his muscular power before and after a few days of enforced confinement in bed; and there is no doubt also of the growth and increased strength of muscle by exercise. If any man changes his occupation, say from a clerk to a blacksmith, the comparison of power in the muscles of his arm at the end of a year will be found to prove this statement most efficiently; but if the blacksmith gives up his anvil and takes to the pen, within a year the powerful deltoid muscles which he formerly possessed will be dwarfed and comparatively impotent for power. Let a man or a boy have sufficient intervals of rest between his times of labour, and whether that labour is brain work or muscle work, it will tend to increase the power of the organ exercised, and the action of the one will by its own work clear the blood from the debris which has been produced by the work of the other. The more powerful minds will therefore be found among those men who do not neglect their muscular development; whilst the total neglect to mental work, which bodily labour sometimes compels the sons of toil to submit to, keeps them at a lower level in the scale of humanity than will be the case when both organs are allowed a chance by being worked alternately, as they ought to be in every well-ordained school. We must bear in mind that by exercise the individual fibres of a muscle increase in size, new molecules are developed from what are called the connective tissue corpuscules, which lie in the interstices between the fibres of the muscle. The contraction of the muscle is one of the means by which an ample supply of blood is brought for the nourishment of the new tissue. If this exercise is not forthcoming, the tissue dwindles and becomes fatty in its character, loses its proper elasticity, and does not leave room for new cells to take its place, for it is not removed in the way that a regularly-exercised muscle is. The elaboration of new muscle is the immediate effect of the activity of the old, and if the old is not used, it fails when a sudden call is made upon it.

It is however possible to carry on exercise to too great an extent, and whilst some schools ignore the necessity, others go on the wrong principle and carry it on to excess. So long as muscle conforms to what is called the principle of rythmic nutrition, its bulk and effective power increases; but long-continued over exertion tends to induce a condition of chronic exhaustion, ending in wasting and decay. There must be time between the movements for the removal of *débris* and for the recharging of the battery of nerve power which directs the movements; otherwise the symptoms which indicate muscular exhaustion come on. These are sometimes very marked when exertion is confined to a very small class of muscles. It is sometimes so marked as to constitute a distinct disease, and is called by various names, as scrivener palsy, type setters', violinists', tailors', or milkers' cramp. Various trades in which only one set of muscles is used, and used continuously for many hours together, are subject to these conditions. The causes which produce such states give us insights into the conditions which are to be avoided in the playground. 'Professional muscular atrophy' is the result of a condition which is the opposite to nonuse.

Besides the muscles which may suffer from over-exertion, the blood vessels are liable to injury. Foundations are laid for mischiefs later on in life, and dilatation of the cavities of the heart, or of the large blood-vessels allow of aneurism being set up, or the smaller arteries and veins give rise to a state corresponding to varicose veins in the leg, which are the result of too long-continued muscular exertion. Athletic exercises, therefore, may be in themselves sources of danger, and violent and long-continued work, either at cricket, or boating, or at football, or in the racket-court, must not be allowed at all to those who are not trained to it, and who have not gradually brought their powers into accord with the work they are called upon to perform.

There is an outcry at times against the continuance of violent athletic sports. It seems to me highly undesirable that they should be abolished; they ought, however, to be carried on under regulations which the monitors and masters in the school should enforce. These pastimes, when carried on in large assemblages of young men, should be under regulations supervised by a responsible officer; and racing crews, football teams, and cricket elevens, intending to enter into contest with other similar parties, should be picked out from men who have been gradually inured to the work, and who have not been absent from proper drill for any length of time together. A boy has, perhaps, been away from school on account of illness or for some temporary cause; and after an absence of two or three months, on his return takes his place at the head of his team, he enters at once into some contest in which there is a call for sudden and long-continued exertion; the result is the foundation for a disease of the heart, or dilatation of some artery, which produces aneurism at some later stage of his life, or some other strain arises, the effects of which are permanent. Extreme exertion embarrasses the heart; the flow of blood is impeded from the right side of it, for the increased pressure of air upon the inner surface of the air-cells impedes the flow of blood through the lungs. These air-cells are sometimes ruptured, and that happens in the boy which is recognised in the horse when a state of things arises which leads to the condition called 'roaring.' If there has been a proper training, this does not arise. The individual is said to have gained his 'second wind;' he breathes regularly, and, under heavy and long-continued exertion, goes on properly, and he is enabled to continue up to the limits of muscular exhaustion, unless stopped by a stitch in his side. This stitch arises from the liver becoming engorged with blood, and it is unable to transmit the quantity through it which rapid exertion has brought into the venous system of the lower extremities and the bowels.

The skin flushes during active exercise, there is congestion of the cutaneous vessels, and perspiration results. This action keeps the temperature of the body at its normal standard. If the skin acts imperfectly, the accumulated heat excites languor and indisposes to further exertion, just as in the case of the lungs. If the boy is in good training the circulation goes on properly. There is not profuse perspiration, but only sufficient to carry off excess of heat. It is important, however, for boys to beware of

the dangers which may result from the custom of trying to cool themselves when too hot, by allowing evaporation to be as rapid as possible. A large loss of heat takes place in this way. The pores of the skin are suddenly closed by the cold, and the discharge of *débris*, which was taking place with the sensible perspiration, is stopped; the excretion is thrown back into the circulation in a state which does not belong to it, and, as a consequence, a condition arises which is called 'taking cold.' It really is a state of self-poisoning by returning into the circulation some morbid matter which ought not to be there at all, and which the skin was naturally excreting. When a boy is very hot, it is better not to allow this gradual chilling to take place upon any account whatever. If he has been running just before he goes into his bath, let him strip and plunge in as quickly as possible, and come out again in a very short time. The bath will refresh him, and the reaction will bring back to the skin that which was being excreted; but if the vessels are allowed to be cooled too much, they will not again relax, and there is no power to continue the process of excretion in a proper manner; the boy remains languid and tired, and it may be that a serious illness is set up. It is unwise to go into the water when in a great heat at all, unless a sudden plunge in and out is alone indulged in, in which case there is a refreshing action; but boys, as a rule, should not take violent exercise just before bathing.

Just as particular muscles may suffer from professional atrophy, so certain parts of the brain may suffer in a similar way. If a boy is kept at one form of work too long—say if he is not allowed to do anything else than try to solve some of Euclid's problems, or if he sets himself to do some such task—it is possible that there may be over-strain of that particular part of the brain upon which mathematical power may depend, and such an one will never become a reasoning genius.

Brain-work must have its rythmical movement, as muscle. There must be time for the removal of used-up brain matter, time for the renewal of new tissue, and for the recharging of the nerve battery, which has been used up in the work which has been done. Teachers are great sinners in this respect. They neglect physical exercise themselves, and, as a consequence, get a low standard of health, suffering as much as most men from these conditions, which are styled bilious, and which they connect with indigestion, but which really arises from the retention within their circulation of the *débris* of nerve tissue and the remains of used up nerve force.

Space will not allow me to go into the different forms of exercise, or to analyse the muscular movements which are brought into play in each kind. The cultivation of muscle is being recognised as a part of school work, and each in its turn becomes a useful part of muscular training. 'Training,' says an eminent writer, 'is to put the body, with extreme and exceptional care, under the influence of all the agents which promote its health and strength, in order to meet extreme and exceptional demands upon its energies'; but I have met with instances in which so-called 'training' has done everthing but this. It has not promoted health and strength, but has exhausted the bodily power, and done more mischief than good. The course of training which is recommended by the fast men of University life, or by the pugilists of fifty years ago, is not the training which boys and girls ought to submit to, except so far that the habitual use of intoxicating liquors is rightfully and reasonably prohibited; and stimulants are in no case required to produce a development of either mind or body. The requirements of a growing body are not the same as those which belong to the adult. In the one case, muscular exercise is used for the purpose of development; in the other, it is used to remove the *débris* which arises from the act of living, and in order to preserve the constitution from the dangerous result of the oxidation of this *débris* in the wrong place and at the wrong time. If one set of muscles develop in the child, and not the other, there is distortion of frame and a want of grace and of elegance in movements. The chest may be contracted, and the lungs deprived of the room which they ought to have for the necessary purification of the blood. Gymnastic and calisthenic exercises tend to produce a straight back and an upright figure; the avoidance of them may lead to round shoulders, twisted spine, stooping and shuffling gait, and shortness and imperfection of vision. The curvations of spine which are common to young girls in consequence of the want of exercise, lays the foundation of much of that mortality, or, at the least, of the acute suffering which follows upon child-bearing later on in life. Spinal curvatures are more common amongst girls than boys, because the latter do get more natural exercise than the former.

Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

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No. IX.—THE THYSANURA AND NEUROPTERA.

BY some authors considered as merely a branch of the *Orthoptera*, the small and insignificant order of the *Thysanoptera*, or *Thysanura*, deserves a passing mention.

The insects belonging to this order, which are popularly known as Thrips, are chiefly remarkable for their ravages in greenhouses, etc., where, in spite of their minute size, they often cause considerable havoc. To the naked eye many of these insects are almost invisible, our largest British species barely reaching the twelfth of an inch in length. When placed beneath a tolerably high power of the microscope, however, they become very interesting objects.

The wings are seen to be curiously fringed with long tassel-like hairs, whence the title '*thysanoptera*'—*i.e.*, 'tassel-winged'—was given to the order. The parts of the mouth are of a somewhat anomalous character, the slender, bristle-like jaws resembling those of the *Hemiptera*, while the other organs are more like those of a mandibulated insect. Owing partly to this curious structure, and partly to the nature of the metamorphoses, the position of these tiny insects was for many years uncertain, but it now seems tolerably certain that they constitute a separate order, and are rightly placed in their present situation.

The thrips have occasionally caused considerable damage to the wheat crops, both in this country and on the Continent; fruit of various kinds also sometimes suffers from their attacks.

The *Neuroptera*—*i.e.*, 'nerve-winged' insects—may be easily recognized by the wonderfully complicated

system of nervures which supply the necessary rigidity to the wings. All winged insects possess these nervures in some form or other, but in none are they so highly developed as in the species composing this order, whose wings are divided into a vast number of small cells by the network of nerves. Generally speaking, all four wings are of equal size.

Although the *Neuroptera* are not largely represented in Great Britain, our species are, as a rule, both large and plentiful, and are therefore familiar to almost every dweller in the country.

The Stone-flies, which are so largely utilized by anglers as bait, form the first family of the order. These insects may be found in great numbers in the neighbourhood of running water, resting sluggishly upon stones and other objects upon the banks of the stream.

During the earlier stages of their existence, the stone-flies lead an aquatic life, the eggs, which are enclosed in a blackish membrane, being deposited in the water by the female insect. It is a curious fact

Larva of Dragon-fly (showing mask).

that these eggs are carried about by the parent for several days, just as is the case with those of the cockroach.

The larvæ usually conceal themselves beneath submerged stones, or in some other sub-equatic retreat, and prefer those parts of the stream where the water runs with the greatest force.

In the *Ephemeridæ*, commonly known as May-flies, we find many points of interest.

The perfect insects differ from the generality of the *Neuroptera* in the size of the hinder wings, which are considerably smaller than the anterior pair. Owing to this peculiarity, these insects have sometimes been considered as forming a separate order, to which the title of *Anisoptera*—*i.e.*, 'unequal-winged' insects—was applied.

Another peculiar feature of the May-flies lies in the absence of a mouth in the perfect insect. It is true that the parts of the mouth may be distinguished by the aid of the microscope, but they are only found in a rudimentary condition, and utterly unfit for the reception of food.

At the extremity of the body are seen either two or three long filaments, by means of which the insect may be readily recognized.

Although the existence of the *Ephemera* is considered at most to extend over a single day, the life of the insect in reality embraces a much longer period of time, two years being occupied in the preliminary stages of its development. The larva, which, like that of the stone-fly, is an inhabitant of the water, constructs for itself a tunnel in the mud, formed with two outlets, and very much resembling in form the capital letter U; its food consists of decaying vegetable matter.

In appearance the larva of the May-fly is somewhat remarkable, being provided with two rather long antennæ, which far exceed in dimensions those of the perfect insect; the extremity of the body is furnished with three fringed bristles, or *setæ*, and along each side of the body runs a series of thin plates, in which are the gills.

The pupa differs in outward form in a very slight degree from the larva, the chief distinction lying in

Demoiselle Dragon-flies.

the hump upon the thorax, in which are concealed the rudiments of the future wings.

When the preliminary stages of its existence are completed, a very singular circumstance takes place.

The pupa leaves the water, and, ascending the stem of some plant, undergoes its change to what we might consider the perfect insect, the wings being fully developed, and the insect possessing and using the power of flight.

Yet this, strange to say, is not its final form, for, after a short space of time, the skin again splits, and the insect crawls forth, leaving its cast-off garment behind it. The wings are now lighter, and of a more delicate nature, and the filaments at the end of the body considerably increase in length.

This intermediate stage is scientifically known as the *pseudimago*, or 'false-perfect' insect, and popularly as the 'Green Drake' of anglers, the perfect insect itself bearing the title of Grey Drake.

Once having attained to the perfect condition, the life of the May-fly is a question of only a few hours,

its existence seldom exceeding the duration of a single day.

We now come to perhaps the most interesting group of all the *Neuroptera*, namely, the *Libellulidæ*, or Dragon-flies.

Swift and active of wing, and possessed of insatiable appetites, these creatures, alike in their larval, pupal, and perfect stages of existence, are the very tyrants of the insect world, myriads of the inhabitants of the water falling victims to them while yet in the earlier stages of their existence, while the perfect dragon-flies are equally destructive among the denizens of air. Not even the swift-flying Scarlet Admiral butterfly can escape from them, its powers of flight being quite inadequate to allow of its escape from its active and vigilant foes. And the dragon-fly possesses the curious and probably unique faculty of reversing the action of the wings, and, without turning, the direction of its flight; so that it is able to pursue its quarry among the foliage of trees, etc., and thus prevent any chance of escape, while it is able to make its own retreat without the slightest difficulty.

In many parts of the country these insects are known as 'Horse-stingers,' owing to the very mistaken idea that they sting horses. There is not the slightest foundation for this idea, the dragon-fly being perfectly harmless excepting to the insects upon which it preys. It is true that, when captured and held by the wings, it will twist its long and slender body about in a manner very suggestive of the possession of a sting, and may thereby, very likely, induce its captor to restore it to freedom. But in reality there is no trace whatever of a sting, that weapon being found in some of the Hymenoptera alone, and, even then, only in the female insects.

Libellula depressa.

The life-history of a dragon-fly is of a singularly interesting and remarkable nature.

The eggs are deposited in the water by the parent insect, which may often be seen resting upon some floating object, with the tip of her abdomen dipped below the surface. The larvæ shortly hatch, and at once enter upon the predacious life which they lead during the remainder of their existence.

For this predacious life they are admirably adapted in every way.

As many of the insects, and other inhabitants of the water, are possessed of considerable swimming powers, their own locomotive apparatus must be developed in a corresponding degree. Such we find to be the case, but in a manner wholly different to what we might reasonably expect.

If we place one of these larvæ in a glass vessel of moderate size, and watch its habits for a short time, we shall be surprised at the rapidity with which it passes through the water and alters its course at will. And, more remarkable still, the means of propulsion will be absolutely invisible, the insect appearing to move without exertion of any kind.

Let us sprinkle a little fine sand at the bottom of the vessel, and we shall quickly find a clue to the mystery.

We shall see that this sand is thrown up behind the insect at tolerably regular intervals, in somewhat the same manner as if we had discharged the contents of a syringe beneath the surface of the water, although, of course, upon a much smaller scale. Now let us take the larva from the water, and subject it to close examination.

We shall find, at the extremity of the body, an appendage consisting of five spike-like objects, which can be separated and closed at the will of the insect. Concealed by these is the entrance to a passage, sufficiently large to admit an ordinary pin, which runs through the centre of the abdomen for the greater part of its length. By the agency of this tube the insect is enabled to swim.

It will be seen that, if the tube is filled with water, and suddenly compressed, the force of the expelled fluid upon the surrounding water will propel the insect forward, just as a sky-rocket is driven into the air by the action of the ejected gases upon the atmosphere. This is the whole secret of the swimming powers of the dragon-fly larva, the tube being alternately filled with water and forcibly compressed by the powerful muscles of the abdomen.

The swimming tube also fulfils a second and equally important function, somewhat analogous to that performed by the gills of a fish.

Although the dragon-fly larva requires a constant supply of oxygen, it is yet not obliged to seek it at the surface, as are the generality of water insects, but is enabled to extract the requisite amount from the water by means of the swimming tube. In the interior of this are placed the spiracles, instead of upon the outer surface of the body, as is usually the case.

Beneath the head of the dragon-fly larva, and extending as far as the junction of the first pair of legs with the thorax, will be noticed a curious horny plate. This can be unfolded by means of a pin, and will then be seen to consist of several joints, the last of which is furnished with a pair of powerful jaws.

This apparatus, which is known as the 'mask,' is used in seizing the prey. Swimming silently beneath its intended victim, the dragon-fly larva approaches within striking distance. The mask is then thrown sharply upwards, and the insect seized in the horny jaws. Once captured, the mask is contracted, and the victim held against the mouth, where it is retained until completely devoured.

This larva is not a very handsome creature, being a slender insect, of a pale olive-brown colour, with rather long legs. The pupa is but little different, the methods of eating, breathing, and swimming being precisely the same, and the only apparent alteration

consisting in the appearance of a hump upon the thorax, in which the future wings are enclosed.

When the time approaches for its change into the perfect condition, the pupa becomes sluggish and entirely loses its appetite. Warned by instinct, it crawls up the stem of some water-plant, leaves its late element behind it, and emerges into the air, where it rests for a few moments, clinging tightly to its foothold.

After the lapse of a few minutes, the skin bursts, and the dragon-fly crawls forth, its wings still limp and crumpled, and as yet unfit to bear their owner through the air. By degrees, however, the folds disappear, the membrane acquires the necessary strength, and the dragon-fly launches itself into the air, and immediately sets forth in search of prey. Although its development is completed, its appetite is as voracious as ever, and insect after insect falls a victim to its insatiable hunger. Even if captured and held between the fingers, it will continue to feed, and will devour more bluebottles than its captor will care to supply.

We have many species of dragon-fly in this country, most of which are plentiful, and may be seen in numbers towards the end of summer flying over almost any pond. The pretty Demoiselles, seeming almost fairy-like in their delicate grace, the yellow-bodied *Libellula depressa*, and many others, may be seen hawking for prey, passing from place to place with the most wonderful rapidity, and ever and anon capturing a hapless insect, which is devoured almost as soon as fairly seized.

As is the case with many of the most brightly-coloured insects, the tint of the dragon-flies, brilliant as they are during life, fade and often entirely disappear in death. A collection of dragon-flies, therefore, can give no idea of the beauty of the living insects, the reds and greens and blues all merging into the one uniform tint of brown. No method of preventing this alteration has yet been discovered, and it would seem that the only way to do so would be to take the insect to pieces, carefully paint the interior, and join the fragments again with cement. Even this process, however, would probably prove unsatisfactory, and the dried specimens would present a very different appearance to the living insects as they sport in the sunshine.

Many interesting foreign insects, such as the Antlion and the Termite, or, as it is wrongly termed, the White Ant, belong to this order; but, as our space is limited, we must pass them by and turn to another of our British *Neuroptera*, namely, the Lacewing Fly (*Chrysopa vulgaris*).

This exquisite insect may often be seen flying in the dusk during the summer months, looking on the wing very much like a small white moth. When captured, however, it is seen to be of a pale green colour, with iridescent wings, various tints playing over them by turns.

The eye of the lacewing fly is a truly wonderful object, far surpassing both in brilliancy and depth of colour that of any other insect.

So graceful and delicate an insect would secure unmingled admiration were it not for one most unpleasant property it possesses, *i.e.*, the power of exuding a liquid of the most nauseous and penetrating odour that can possibly be imagined. A mere touch is sufficient to bring out this evil perfume, and even repeated ablutions will hardly lessen its potency, several days sometimes elapsing before its traces finally disappear.

The lacewing is one of our many unrecognised insect benefactors, the larva uniting with the various ladybirds in their attacks on the destructive aphides. It has the peculiarity of clothing itself with the skins of its victims, after sucking their juices, in such a manner that its form is almost entirely concealed. Its ravages are, however, not entirely confined to those mischievous little insects, for it will even devour its own comrades, should they happen to meet with one another.

The ova are deposited in a somewhat remarkable manner, each egg being fastened upon a separate footstalk, half an inch or so in length. These footstalks are formed from a viscous fluid secreted by the parent insect, a minute drop being exuded upon a twig or some other object, and the body suddenly withdrawn. The gummy fluid is thus drawn out into a thread, upon the extremity of which the egg is placed.

A number of these eggs are always placed together, and present a very curious appearance, closely resembling the capsules of various mosses. Indeed, by many authors they have been considered as mosses, and described and figured accordingly.

(To be continued.)

Anecdotal Natural History.

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No. XI.—THE ELEPHANT.

THE Elephant belongs to the curious family of the Pachyderms, or 'thick-skinned' animals, which also includes such apparently dissimilar creatures as the little Hyrax, or 'Coney' of the Scriptures, and the various swine.

At first sight, and judging by their outward forms, these animals do not appear to have very much in common, and it may seem somewhat strange that they should have been included in the same family. An examination, however, of the fossil animals of the group supplies the requisite links, and affords conclusive proof that all these animals really belong to one and the same division.

As is well known, there are two distinct species of elephant, the one inhabiting Africa, while the other is a native of various parts of the continent of Asia. As far as their chief characteristics are concerned, the two animals are sufficiently alike to allow of a single description sufficing for both.

The most singular part of the structure of the elephant is, of course, the proboscis, or 'trunk' as it is popularly called, upon which the very life of its owner depends. This wonderful organ is, in reality, merely a development of the nose and the upper lip, the nostrils running through its entire length. The extremity is furnished with a curious finger-like appendage, which is of so delicate a nature that it can pluck a single blade of grass if required.

The proboscis is formed alike for strength and flexibility, and is provided with the enormous number

of fifty thousand distinct muscles, some running longitudinally along the proboscis, while others radiate from its centre.

Upon the proboscis the entire nourishment of the animal depends, and, were it deprived of that organ, starvation would inevitably ensue. The short and thick neck would prevent it from grazing, while the long tusks would hinder it from devouring the herbage which grew on a level with its body. Water, also, could no longer be obtained, and thirst and hunger combined would shortly end the sufferings of the mutilated animal.

In somewhat the same manner as the camel, the elephant possesses the faculty of storing up water in the interior of the body, and is, moreover, able to withdraw it when required by means of the trunk, and sprinkle it over the body, in order to cool the heated surface.

The method of drinking is somewhat peculiar. Inserting the tip of the trunk into the pool, the animal sucks a quantity into its cavities; the proboscis is then reversed, the end placed in the mouth, and the fluid discharged down the throat.

In providing food, too, the trunk answers much the same purpose, first plucking the leaves, etc., and then placing them in the mouth.

The head and skull of the elephant are formed in a very curious manner, affording a most wonderful example of strength combined with lightness. The former quality, of course, is indispensable, the enormous weight of the tusks and proboscis necessitating the provision of large and powerful muscles, while the advantage of the latter is self-evident.

In order to satisfy these demands, the bony plates which form the skull are separated from one another, and form a series of cells, each of which contains a number of smaller chambers, bearing, in fact, a considerable resemblance to a honeycomb. These cells are filled with a thick oily fluid.

In the midst of these cells lies the brain, which is remarkably small in comparison to the size of the animal, and is thus protected from the effects of the various concussions it would inevitably receive during the headlong rushes of its possessor.

In like manner, too, this structure protects the animal in a great measure from the bullets of the hunter, for, unless they should happen to enter by the eye, the ear, or the nostrils, the leaden missiles stand but little chance of reaching the brain, burying themselves in the cellular mass, and doing comparatively little damage. An elephant has been known to receive between twenty and thirty large balls in the head alone before finally succumbing to its wounds.

It is, however, a somewhat curious fact that the skulls of the African and the Asiatic elephant are not formed exactly in the same manner, although the curious cellular structure is found in both, so that a bullet, which to the one would cause little injury, would to the other be certain death.

For example. If a hunter stands in front of an Indian elephant, and sends a bullet into the spot where the proboscis joins the head, the animal falls dead without a struggle, the bullet having penetrated to the brain. But if he were to attack an African elephant in the same manner, the bullet would pass above the brain, and waste itself in the cells of the skull, only irritating, and not injuring the elephant.

The limbs of the elephant, also, are admirably adapted to sustain the immense weight of the animal. Stout, and comparatively short, they are set perfectly upright, like so many pillars; the hinder pair, also, are without the elongated cannon-bone, so that the so-called 'knee-joint' is absent, while the real knee is very conspicuous.

The elephant is a far more active animal than might be supposed, judging by outward appearance, his speed when excited being almost equal to that of a fleet horse. On rocky and mountainous ground, too, he is perfectly at home, notwithstanding his bulky proportions, and will ascend and descend acclivities where a horse is utterly unable to gain a foothold.

His method of descending precipitous ground is very singular. Kneeling down, with the fore legs stretched out in front and the hinder ones bent backwards, he gradually lowers himself towards the ground, making use of every little inequality in the surface, or scraping a foothold with his hoof, should a convenient one not be otherwise attainable. If the declivity be very steep, he pursues a winding course, just as does a horse in ascending a hill.

The foot of the elephant is wonderfully suited to the work it has to perform. The hoof which encloses it is formed of a vast number of horny springs, similar to those found in the hoof of the horse, which protect the foot from any concussion against the ground, and enable the animal to move with surprising ease and silence. Notwithstanding the huge bulk of the body, the tread of an elephant is perfectly noiseless, and as the animal possesses the faculty of forcing its way through the thickest jungle without snapping even a twig, a hunter may be in close proximity to a herd of moving elephants, and yet not be in the slightest degree aware of their presence.

The toes, five of which are found in each foot, are almost entirely encased in the hoof, and are only partly visible to outward inspection.

The tusks of the elephant vary according to the sex, age, and species of the animal, being most highly developed in the male of the African variety. They do not, as might be imagined, spring from the jaw itself, but, like the teeth of the bottle-nosed whale, proceed from a vascular formation found upon the gums.

The molar teeth appear to be formed of a number of smaller teeth, which are closely fastened together, so as to form a single large mass. These are set obliquely in the jaws, and are gradually worn away by constant use, fresh teeth taking their places as often as required. In this manner, an elephant may have seven or eight sets of teeth, each set increasing in size in proportion to the growth of the animal. The incisors, which are found in the upper jaw only, are long and projecting; the canines are altogether wanting. The size of the elephant is generally much exaggerated, even a large animal seldom exceeding ten feet in height, while the average is a foot or so less.

The elephants of both continents alike are almost invariably found in herds, varying considerably in point of number, which are always under the guidance of some old and experienced leader. They dwell in the thickest forests, being seldom found at any great distance from water.

During the drought of summer, of course, the smaller streams often run dry. In such cases, the reasoning powers of the animals come to their assistance, and the elephants, as Sir Samuel Baker tells us, in

his well-known work 'Eight Years in Ceylon,' 'make use of their wonderful instinct by digging holes in the dry sand of the river's bed; this they perform with the horny toes of their fore-feet, and frequently work to a depth of three feet before they discover the liquid treasure beneath.'

WE will now devote our attention to a description of the habits, etc., of each of the two species, taking the Asiatic animal first in succession.

This elephant may be at once distinguished from its African relative by the size and form of the ears, those organs being in the Asiatic animal proportioned to the dimensions of other parts of the body, whilst in the African variety they are of very great comparative size, almost meeting at the back of the head, and hanging considerably below the neck. An African hunter has been known to shelter himself under an elephant's ear during a storm, and to emerge perfectly dry when the storm had passed over. The head of the former, also, is elongated, and the forehead concave, while in the latter the very reverse is the case.

Another point of distinction, too, is found in the molar teeth, the enamel upon the surface of those of the Asiatic elephant being moulded into a number of narrow bands, while in the African species it is formed in a series of diamond-shaped folds.

In the Asiatic species, too, the tusks are found only in the males, and are not possessed by every member of even that sex. When present, they are, generally speaking, very much inferior both in size and quality to those of the African animal.

The Asiatic elephant is chiefly remarkable for its services to man when trained to do his bidding. In all work which necessitates the employment of great strength united with intelligence, the value of the animal is inestimable. In such operations, for instance, as piling logs, laying dams, or even building walls, elephants are largely employed, their enormous strength and quick judgment rendering them most valuable auxiliaries.

These advantages are, however, not unmixed with drawbacks. The health of the animal, for example, requires constant care and attention; the skin, thick as it is, is liable to abrasions, resulting in ulcerous sores; and the eyes are constantly subject to inflammation.

Taking these disadvantages into consideration, many writers are of opinion that the value of the elephant as a beast of burden is greatly over estimated, and that he is in reality of little more use than a powerful dray horse, which can work for longer hours, and is not so subject to sores and inflammations.

As far as some of the operations performed by elephants are concerned, this theory may be true enough, but when we consider the enormous weights which these animals are accustomed to carry, and the precision with which the largest and heaviest beams are placed by them, it seems hardly possible that their duties could be adequately performed by any other animal, no matter how powerful and intelligent it might be.

Another of the manifold purposes for which the Asiatic elephant is employed is that of an auxiliary in the chase of the tiger.

In order to serve in this capacity, the animals are captured when very young, and are carefully trained to perform their future duties. This is no easy task, for in the very nature of the elephant there appears to be an ingrained dread and abhorrence of the tiger, causing it to fly in terror from the mere sight of the skin of the fierce beast.

The education, therefore, of the hunting elephant is a matter of care, time, and patience, and is conducted as follows.

A tiger-skin is procured and stuffed, in order to resemble as far as possible the form of the living animal. This is continually presented to the elephant until he loses his natural fear of the striped skin.

The next step is to teach the animal to gore his foe with his tusks, and trample him under foot.

Next, a boy is placed inside the skin, in order to counterfeit the motions of the living tiger, and, finally, a dead animal is substituted for the stuffed skin.

Yet, with all the preliminary training, the elephant is seldom to be depended upon in the hour of actual danger, the rush of the furious tiger often causing the huge animal to turn tail, and fly before the onslaught of its foe.

During these expeditions, the animal is guided by a driver, or 'mahout,' who sits astride upon the neck, directing the animal by means of a spiked-hook, or 'haunkus,' which is placed against the head of the elephant in such a manner as to convey the driver's instructions to the animal. The hunters ride in a 'howdah,' or car, which is fastened upon the elephant's back.

The elephants intended for domestication are captured in two ways. In the first of these, 'koomkies,' or trained female elephants are employed, which divert the attention of the intended captive from his approaching foes, who even creep beneath his body without alarming him, and place nooses of strong rope round his limbs. The ropes are then fastened to convenient trees, the koomkies called off, and the elephant finds himself a prisoner. For a time he struggles to release himself from his bonds, but finally yields to his captors, and is led off to a place of security.

The second method of capturing the elephants is of a far more comprehensive nature, all the members of one or more herds being included in the attack.

For this purpose a large enclosure, or 'keddah,' is formed of stout posts, which are driven into the ground at such a distance from one another as to allow a man to pass freely between them. A head of elephants is then surrounded by hunters, and gradually driven towards the keddah, the door of which is left open.

By slow degrees, the operation sometimes extending over several weeks, the animals are forced into the enclosure, the entrance to which is immediately closed.

Should the animals attempt to burst from their place of confinement, they are immediately driven back by torch-bearers, who thrust their flaming brands into the faces of the excited captives, and deter them from breaking through the walls. After a time, the imprisoned animals relax their efforts to escape, when the hunters cautiously enter, and bind each of them securely to a tree, or other immovable object.

The nature of the Asiatic elephant is, as a rule, very quiet and peaceable, forming a great contrast to the fierce and savage character of its African relative.

Even when hunted, if it should be successful enough to strike down its foe, the animal seems to have little idea of revenge, and usually contents itself with kicking its prostrate adversary from foot to foot without causing any great injury.

It may seem remarkable that a domesticated animal should be desirous of reducing its fellows to a state of servitude. Yet the elephant does so, the females using every means in their power to capture the males.

One case is known where a female escaped from her owners, carrying with her a chain. In a few days she returned, and by signs and sounds told her keepers that she wished them to accompany her into the forest. This was done, and then she led them to a spot where a fine male elephant was found chained to a tree. In fact, she had acted the part of Delilah towards Samson.

THE African elephant (*Elephas Africanus*) is spread over a large tract of country, extending from Abyssinia to the borders of Cape Colony. Like the Asiatic species, it is an inhabitant of the thick forests, seldom venturing into the open country.

This elephant is also much sought after, although from very different motives to those which influence the hunter of the Asiatic animal.

The natives of Africa are either not aware of the services rendered by the elephant when captured and carefully trained, or mingled apathy and fear prevent them from availing themselves of their opportunities. Just the same is the case with the Chetah, or Hunting Cat, which in Asia is carefully trained for purposes of the chase, while in Africa it is allowed to remain in freedom. Formerly, however, the African elephant was trained for purposes both of war and peace, just as is now the case in India.

The ivory of the tusks forms the principal incentive to the efforts of the hunters engaged in the chase of this animal, being of very fine quality and considerable value. An ordinary pair of tusks, weighing, perhaps, rather over a hundredweight, will fetch thirty-five or forty pounds, although the price varies slightly according to the condition of the market.

The flesh, too, is by no means an unimportant article of diet, especially among the natives, to whom the slaughter of an elephant is an occasion of great rejoicing. Some parts, such as the foot, are justly considered as especial dainties, but the greater portion of the flesh is stated by many travellers to be little superior in toughness and flavour to ordinary shoe-leather.

The foot is baked in a somewhat curious fashion. A fire is lighted upon the ground, and allowed to burn itself out. A hole is then dug beneath the spot, and the foot is inserted, being then covered up with the warm earth. A second fire is then lighted, which is also suffered to burn itself out, and when the earth is thoroughly cool, the process is complete, and the dainty in perfect order for the table.

Until the advent of firearms, the slaughter of an elephant was only a very occasional event with the natives, who were either obliged to follow it for days, attacking it with their spears at every opportunity, until the animal fell from sheer exhaustion and loss of blood, or to trap it by means of pitfalls.

These latter are still employed, being dug in the paths of the animals, and covered over with boughs and earth to imitate the surrounding surface. With the old and experienced leaders, however, these precautions are of little avail, for the crafty animals test every inch of ground with their trunks before trusting their weight upon it.

Should one of the animals, however, be unfortunate enough to fall into the snare, it has no chance whatever of escape, a sharp upright stake being fixed in the centre of the pit, upon which the luckless creature is impaled by its own weight.

In their wild and free state, it is probable that elephants live to a very great age, and even when domesticated, appear to be long-lived animals; there have been several apparently well-authenticated instances of these animals attaining the age of two hundred years.

(To be continued.)

'How I Teach Elementary Science.'

BY RICHARD BALCHIN,

Head Master of the Gloucester Road Board School, London.

FOURTH SCHEDULE SUBJECTS: MECHANICS.

I PROPOSE in this article reproducing one of the lessons in the second stage; subject:—'Velocity or rate of motion; measure of velocity; accelerated, retarded, and uniform velocity.'

Here is a picture, Jones; what does it seem to be a picture of? Ans.—Two men walking. Can any boy tell me something else about it? Ans.—One man is carrying a very small bag, and walking fast. The other has a heavy load on his back, and seems to be going slowly. Can you see anything else in the picture? Ans.—A train going over a bridge. What would you say about the bag the man is carrying? Ans.—It is very small; very light. And about the load? Ans.—It seems to be very heavy. Can you tell me *how* light the bag is? Ans.—About three or four pounds. Yes, I should think about that. And the load? Ans.—About thirty or forty pounds. Well, I should say about sixty. Look at this feather; see how slowly it falls to the ground; why is that? Ans.—Because it is so light. Would the little bag do so? Ans.—No, sir. Why not? Ans.—Because the bag is heavy. Indeed; you just said the bag was light? Ans.—Yes; the bag *is* light compared with the load; but it is heavy compared with the feather. Just so. You see, therefore, that the words 'light' and 'heavy' only show the weight in relation to something else. If we wanted to state exactly *how* light or *how* heavy each of the things is, what terms must we use? Ans.—We must say how many pounds or how many ounces it weighs. Yes; in other words, we must use some measure of weight. Now, you just said that one man was walking fast and the other slowly. But look at the train, see the long line of steam and smoke it leaves behind. Is the man with the bag going fast as compared with the train? Ans. —No, sir; quite slow. Yes, that is true; but as compared with the man who has the load what would you say? Ans.—He is going fast. Just so. You see, therefore, that 'light' and 'heavy,' 'slow' and 'fast,' are terms used relatively. We say they are 'relative terms.' I will write that on the board. Now can you tell me exactly *how* fast the one man is

walking, or *how* slowly the other is moving, or *how* fast the train is travelling; just as you said how much the bag or the load weighed? No answer. (A boy)—We want a measure. Do you? A measure of what? Ans.—Of the rate they are going. Can you give me *one* word for 'rate they are going?' Ans.—Quickness; speed; 'motion.' Some boy said 'motion;' but in our last lesson, what did we agree that 'motion' should mean? Ans.—Change of place. Yes; so we must not use it for rate or speed with which anything changes its place. I will give you the proper word and write its meaning:—'Velocity or rate of motion.' Now what we want is a measure of velocity. If we have such a measure, what will it enable us to say respecting the motion of these two men and the train? Ans.—Exactly how fast they are going. And without such measure what is the only thing we can say? Ans.—Only how fast one is going as compared with the other. Yes; what were the terms I told you we should use in this latter case? Ans.—Relative terms. You remember last week we used a word in a sense almost the opposite of relative, what was it? Ans.—Absolute. Just so. Now tell me in what terms we want to speak of the velocities represented in that picture? Ans.—Absolute terms. But in order to speak in absolute terms, what is it we require? Ans.—A measure of velocity. (A boy, putting up his hand)—Please, sir, how can you measure motion? Well, that is what I was about to ask you. Can you weigh velocity? No, sir. Why? Ans.—Because it is not matter. (A boy)—You can measure in feet or in miles the distance anything goes. Yes, you can; but what of that? Ans. (from the same boy)—If the man with the bag goes two miles, and the man with the load goes only one mile, the velocity of the first man is double that of the second. (A boy)—That does not show anything about the velocity they go at, at all. That shows only how far they go. Exactly so, Smith; and can you prove to that boy that what he has said has nothing to do with velocity? Ans.—Yes, sir; I think I can. The first man may take two hours to go his two miles, while the second man may do his one mile in half-an-hour. Quite so; and in that case which one would move with the greatest velocity? Ans.—The second one. Yes; what, therefore, is it we must know if we want to measure velocity, besides the distance passed over? Ans.—The time it takes to go. True: now tell me how we measure velocity? Ans.—By the distance passed over in a certain time. Right: then tell me how you would state the velocity of that train? Ans.—A mile a minute: sixty miles an hour. Yes. We have on the board, you see, 'velocity is rate of motion;' I will write under it:—'It is measured by the space passed over, in a given time.' Have any of you boys ever bowled an iron hoop down a hill? Ans.—Yes, sir. Ah! I remember when I was a boy like you, I was very fond of going up Primrose Hill—that is the name of a little hill just outside of London, on the north—and after tying a white rag to my hoop, send it flying down the hill, while I stood at the top and watched it. Away it would go, at such a rate. I shouted and clapped my hands as I saw it flying away, quicker and quicker, until it got into the level field at the bottom; then it went more than half-way across the field, getting slower and slower, until at last it stopped. Then I would run down myself—so fast; getting up such a rate by the time I got to the bottom; where I generally managed to fall down, roll over and over, and at last stop. I would at once take the hoop to the top again; it was such fun. Now, can you tell me what was the difference between the way the hoop went down the hill, and the way it went when on the level field? Ans.—It went very quickly down the hill, but rather slow across the field. (Another boy)—It went quicker and quicker while it was on the hill, but when it got to the field, at the bottom, it went slower and slower. Just so. Suppose I could notice exactly how many feet the hoop went in any one second down the hill: say in a certain second it went twenty feet; would it travel more or less than twenty feet in the next second? Ans.—More. Yes, I daresay it would go thirty feet; and in the next second still further. Now, for that kind of velocity we have a name, which very likely you have never heard before, so I will write it on the board: 'accelerated velocity.'

You said, that when the hoop came to the level field, it began to go slower and slower, and then stopped. Suppose we noticed exactly how many feet it went in, say the twentieth second before it stopped, and found that in that second it travelled ten feet: in the next second, that is the nineteenth second before it stopped, would it, think you, go more or less than ten feet? Ans.—Less. Why do you think so? Ans.—Because it keeps getting slower and slower. Very true; perhaps it would only travel eight or nine feet; and in the next second still less, and so on, until it stopped. Have you ever heard of the name we give to this kind of motion? Ans.—Retarded velocity. That is quite right, Jones, but how did you come to know that word, I don't think I have mentioned it before in my lessons? Ans. (from Jones)—I read it in our sixth standard reading books. Good: I am quite pleased with you, my boy, for thinking of what you read. Well, I will write this term on the board: 'Retarded velocity.' Now, boys, give me some instances of accelerated velocity? Ans.—A truck running down an incline. Some water running down a steep place. A stone falling to the ground. The bucket going down the well when you let go the handle. Yes, and what as to the handle running round? Ans.—That is accelerated velocity, too. Now, give me some instances of retarded velocity. Ans.—Anything going along level ground. A stone thrown up into the air. Just so, but when does this retarded velocity come to an end? Ans.—When the stone has gone up as high as it will go. Yes; and then what kind of velocity will the stone fall with? Ans.—Accelerated velocity. (A boy holding up his hand.) Well? Please sir, what is the name of the velocity when the thing goes neither quicker and quicker, nor slower and slower; when its goes along all the same? Well, now, do you know of any such velocity? Ans.—Yes, sir; if a train keeps going a mile a minute. Can any boy give me another instance of such velocity? Ans.—The earth going round the sun. Yes, that is very nearly the same. What term, think you, we might apply to such? Ans.—Even velocity. Yes, 'even' is a very good name for it; but I will write on the board the one generally used:—'Uniform velocity.' You spoke just now of a train; tell me what kind of velocity it has on starting? Ans.—Accelerated. And when it is at full speed? Ans.—Uniform. And when the guard puts on the brake to stop it? Ans.—

Retarded. Very good; now I think you may take out your books and write:—Velocity is rate of motion; it is measured by the space passed over in a given time. Accelerated velocity means continually increasing spaces passed over in equal times. Retarded velocity means continually decreasing spaces passed over in equal times. Uniform velocity means equal spaces passed over in equal times. End of lesson. I may here remark, that I always get the boys to learn from memory, the definitions and facts that are written in their exercise books. I need scarcely say, that no printed text-book whatever is put into the hands of the boys.

—o—

Pupil Teacher's Examination Questions.

NOVEMBER, 1881.

CANDIDATES.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. If a pole 10 feet high cast a shadow 12 feet 8 inches long, how high is a tower which casts at the same time a shadow 57 feet long?

2. Compare the cost of 150 oranges at 9½d. a dozen, and that of 3½ lbs. of tea at 2s. 10½d. a lb.

3. Find the total cost of the following:—
   3019 articles at 18s.
   517 articles at £1 18s.
   2466 articles at 16s. a dozen.
   620 dozen at £2 4s. per score.

4. How many yards worth 3s. 7½d. should be given in exchange for 935½ yards worth 18s. 1½d. per yard?

5. 518 ac. 3 rd. 7¾ poles at £118 7s. 6d. per acre.

FEMALES.

1. Make out the following bill:—
   81 yds. silk at 3s. 9d. per yd.
   225 yds. flannel at 1s. 7d. per yd.
   108 yds. serge at 1s. 8d. per yd.
   45 umbrellas at 11s. 6d. each.
   51 prs. of silk stockings at 10s. 7d. per pr.
   360 prs. of gloves at 1s. 2½d. per pr.

2. Find the cost of 7551 articles at £3 15s. 2½d. each.

3. 37 cwt. 2 qrs. 13 lbs. at £4 14s. 6d. per cwt.

4. What is the value of 10,060 articles at one shilling and elevenpence halfpenny each?

Grammar.

1. Parse all the nouns, verbs, and adjectives in the following:—

'It ceased, the melancholy sound,
And silence sunk on all around;
The air was sad, but sadder still
It fell on Marmion's ear,
It plained as if disgrace and ill,
And shameful death, were near.' SCOTT.

Point out and parse all the adjectives and adverbs in the above.

2. Give two examples of verbs in the imperative, and two of verbs in the subjunctive mood.

3. What adjectives are compared by adding *er* and *est* to the positive?

Geography.

Answer two questions.

1. Name in order the river-mouths, bays, headlands, and principal seaports between the Firth of Forth and the mouth of the Thames. Describe briefly the character of each seaport.

2. What differences of climate are there between the east and the west sides of Great Britain? Give reasons for these differences.

3. Say what you know about the physical features and industrial pursuits of Devonshire, Cumberland, and Aberdeenshire.

If you can, draw a map to illustrate *one* answer, and insert the lines of latitude and longitude.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

Write in large hand, as a specimen of copy-setting, the word *Geraldine*.

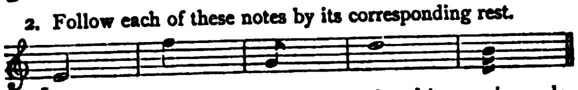
Write, in small hand, as a specimen of copy-setting, *The Programme of Proceedings*.

Music.

A quarter of an hour allowed for this paper.

1. Write, over each of the following notes, its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other).

2. Follow each of these notes by its corresponding rest.



3. How many tones and semitones are found in a major scale, and what places therein do the latter occupy?

ANSWERS.—CANDIDATES.

Arithmetic.

MALES.

1.
12 ft. 8 in. = 152 in.
57 ft. = 684 in.
152 in. : 684 in. :: 10 ft. : height of tower.
10ft. × $\frac{684}{152}$ = 45 ft.

2.

		s.	d.
(*a*) 150 at 9½ per doz. = 12½ doz. at 9½d. each	=	9	10¾
(*b*) 3½ lbs. at 2s. 10½d.	=	10	0¾
(*a*) is less than (*b*) by			2d.

3.

	£	s.	d.
3019 arts. at 18s. = (£3019 − $\frac{1}{10}$ of £3019) =	2717	2	0
517 " £1 18s. = (£1034 − $\frac{1}{10}$ of £517) =	982	6	0
2466 " 16s. per doz. = (2466 at 1s. 4d. ea.) =	164	8	0
620 doz. at £2 4s. per score = 372 at £2½ =	818	8	0
Total cost =	4682	4	0

4. 18s. 7½d. being = 5 times 3s. 7½d., ∴ 5 times 935½ yds. must be given in exchange, *i.e.*, 4677½ yds. Ans.

5.

	£	s.	d.
Value of 1 ac.	= 118	7	6 × 8
			10
	1183	15	0 × 1
			10
	11837	10	0
			5
	59187	10	0
	1183	15	0
	947	0	0
" 518 ac.	= 61318	5	0
" 2 ro. = ½ val. of 1 ac. =	59	3	9
" 1 ro. = ½ " 2 ro. =	29	11	10½
" 5 po. = ⅛ " 1 ro. =	3	13	11$\frac{13}{16}$
" 2½ po. = ½ " 5 po. =	1	16	11$\frac{29}{32}$
" ¼ po. = $\frac{1}{10}$ " 2½ po. =		3	8$\frac{25}{64}$
" 518 ac. 3 ro. 7¾ po. =	£61412	15	3$\frac{33}{64}$ Ans.

FEMALES.

1.

		£	s.	d.
81 yards	at 3s. 9d. =	15	3	9
225 "	" 1s. 7d. =	17	16	3
108 "	" 1s. 8d. =	9	0	0
45 umbrellas	" 11s. 6d. =	25	17	6
51 pairs	" 10s. 7d. =	26	19	9
360 "	" 1s. 2½d. =	21	15	0
		116	12	3 Ans.

		£	s.	d.	
2.	Value of whole at £1	= 7551	0	0	
				3	
„	£3	= 22653	0	0	
„	10s. = $\frac{1}{2}$ val. at £1	= 3775	10	0	
„	5s. = $\frac{1}{2}$ „ 10s.	= 1887	15	0	
„	(1s. = $\frac{1}{5}$ „ 5s.)	= (377	11	0)	*to be omitted in adding.*
„	2d. = $\frac{1}{6}$ „ 1s.	= 62	18	6	
„	$\frac{1}{4}$d. = $\frac{1}{8}$ „ 2d.	= 7	17	3$\frac{3}{4}$	
„	£3 15s. 2$\frac{1}{4}$	= 28387	0	9$\frac{3}{4}$	Ans.

		£	s.	d.	
3.	Value of 1 cwt.	= 4	14	6 × 1	
				6	
		28	7	0	
				6	
		170	2	0	
		4	14	6	
„	37 cwts.	= 174	16	6	
„	2 qrs. = $\frac{1}{2}$ val. of 1 cwt.	= 2	7	3	
„	14 lbs. = $\frac{1}{4}$ „ 2 qrs.	= 0	11	9$\frac{3}{4}$	
„	37 cwt. 2$\frac{1}{4}$ qrs.	= 177	15	6$\frac{3}{4}$	
subtract „	1 lb. = $\frac{1}{14}$ of 14 lbs.	=		10$\frac{1}{8}$	
∴ „	37 cwt. 2 qrs. 13 lbs.	= 177	14	8$\frac{5}{8}$	Ans.

4. 10,060 arts. at 1s. 11$\frac{1}{2}$d. = 10,060 at 2s. – 10,060 halfd.
= $\frac{1}{10}$ of £10,060 – 5,030d.
or 419s. 2d.
= £1006 – £20 19s. 2d.
i.e., £985 0s. 10d.

Grammar.

1. Parsing of *nouns*, *verbs*, *adjectives*, and *adverbs*.
ceased—intrans. reg. verb, indic. past indef. 3rd pers. sing., agreeing with subj. *it*.
melancholy—qual. adj. limiting *sound*.
sound—abstr. noun, neu. sing. nom. in apposition with *it*.
silence—abstr. noun, neu. sing. nom. subj. of *sunk*.
sunk—(= sank), intrans. v. irreg. *sink*, *sank*, *sunk*, indic. past indef., 3rd pers. sing. agr. with *silence*.
all—an adj. used for a pronoun.
around—adv. (modif. 'stood' or other verb).
air—abstr. noun, neu. sing. nom. subj. of *was*.
was—irreg. subst. v. *am*, *was*, *been*, indic. past indef. 3rd pers. sing. agr. with *air*.
sad—adj. limiting *air*, used predicatively.
sadder—adv. compar. deg. modif. *fell*.
still—adv. of degree, modif. *sadder*.
fell—intrans. v. irreg. *fall*, *fell*, *fallen*, indic. past indef. 3rd pers. sing. agr. with *it*.
Marmion's—prop. noun, mas. sing. poss. attrib. to *ear*.
ear—com. noun, neu. sing. obj. gov. by *on*.
plained—(= complained), intrans. reg. v. indic. past indef. 3rd pers. sing., agr. with *it*.
disgrace— } abstr. nouns. neut. sing. nom. subj. *were*.
ill— }
death— }
shameful—qual. adj. limiting *death*.
were—irreg. subst. verb, *am*, *was*, *been*, subj. past indef. 3rd pers. plur. agr. with *disgrace*, *ill*, *death*.
near—adv. modif. *were*, used predicatively.

2. Two examples of verbs in the *imperative mood*—*Read* this. *Stand* at ease; *subjunctive*—*Wert* thou in the cauld blast, I'd shelter thee. I fear lest he *come*.

3. (*a*) Adjectives of *one* syllable are generally compared by -*er* and *est*, as long, longer, longest; safe, safer, safest.

(*b*) *Dissyllables* ending in -*y* (changed into -*i* before -er and -est), -*ble*, -*er*, and -*ow* frequently add -*er* and -*est*; as—happy, happier, happiest; tender, tenderer, tenderest; shallow, shallower, shallowest.

(*c*) Adjectives of all terminations accented on the second syllable often take -*er* and -*est*; as—complete, completer, completest; divine, diviner, divinest.

Geography.

1. The river-mouths, etc., between the Firth of Forth and the Mouth of the Thames are—*St. Abb's Head*, *Mouth of the Tweed*, *Mouths of the Wansbeck* and *Blyth*, *Mouth of the Tyne*, *Newcastle*, great seaport for coal, *Sunderland* at the *mouth of the Wear*, next to Newcastle as a coal port, *Stockton* at the *mouth of the Tees*, has great Baltic trade, *Flamborough Head*, *Bridlington Bay*, *Spurn Head*, *Humber Mouth*, *Hull*, the third seaport in England, trading with the Baltic and the Mediterranean, *Boston* has considerable trade with London, and stands at the *mouth of the Witham*, *the Wash*, receiving the waters of *the Trent* and *the Ouse*, *Hunstanton Cliff*, *Yarmouth* at the *mouth of the Yare*, the great centre of the English herring-fishery, whence herrings are sent to London, the Mediterranean, and the West Indies, *Lowestoft Ness*, *Harwich*, one of the best seaports on the east, at the *mouth of the Stour*, *mouth of the Chelmer*, *the Naze*, *Foulness*.

2. The mountains of the west act as a screen to protect the eastern plains on that side where they are in danger of excessive rainfall, which would injure the crops. As heavy masses of clouds are driven up from the Atlantic, they are caught by the mountain heights, lose their moisture, and originate some considerable rivers. The barren hills on the west are almost continually shrouded in mist, while the districts beyond them receive only the proper amount of water. These facts render the climate of the east coast less mo st than that of the west.

3. *Devonshire* occupies that portion of the south-western mountain group where the moorlands rise to their greatest height and present their wildest scenery.

The county is naturally divided into three parts: (1) *Exmoor*, a high table-land, covered with patches of bog, treeless, and almost uninhabited; (2) *Dartmoor*, a wild and very extensive table-land, the surface is barren, but under it are minerals of great richness; and (3) a broad plain of pasture-land lying between (1) and (2), which forms some of the richest farming-ground in England. The industrial pursuits are mining, agriculture, ship-building at the various seaports, cider-making.

Cumberland has a mountainous surface, with fine valleys between the hills. It contains the chief heights of the Cumbrian mountains, and a number of beautiful lakes presenting the finest scenery in England. There are only three rivers of any importance. The climate being extremely moist, agriculture is chiefly confined to stock-breeding, though green crops are grown to great perfection. There is also coal and iron mining, and Borrowdale has a rich plumbago mine.

Aberdeenshire is mountainous in the S.W. the rest being level or undulating. There are four considerable rivers in the county. Although only one-third of the surface is arable, it is under the most skilful cultivation, and more fat cattle are reared than in any other county of Scotland. There are many granite quarries, and large quantities of the beautiful stone are shipped to London. The rivers are famed for their salmon fisheries.

Music.

3. Five tones and two semitones, the latter being found between the 3rd and 4th, and 7th and 8th notes.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Reduce, add together, and state total of the following five quantities:—£6$\frac{3}{8}$, £19$\frac{4}{5}$, £21$\frac{1}{3}$, £5·75, £14·125.

2. What is the cost of 5$\frac{1}{8}$ oz. of gold when 1$\frac{3}{4}$ oz. are worth £6$\frac{1}{8}$?

3. Reduce $\frac{3}{14}$ of a guinea to the decimal of £.

4. By what decimal is $\frac{13}{15}$ greater, or less, than the product of ·00756122 × 77·482?

5. Divide the sum of £4 5s. 8d. between two people, so that one may have three times as much as the other.

FEMALES.

1. If a gentleman's income be £500 a year, and he spends 19s. 4d. a day, how much will he have saved at the year's end
2. If I pay 10 shillings for the carriage of 2 tons for 6 miles, what must I pay for the carriage of 12 tons 17 cwt. for 17 miles?
3. A gentleman bought a wedge of gold, which weighed 14 lbs. 3 ozs. 8 dwt., for the sum of £514 4s.; at what rate did he pay for it per ounce?
4. How many allowances of 5 oz. 7 drs. each may be cut from seven cheeses, each weighing 1 cwt. 2 qrs. 5 lbs.?

Grammar.

1. Parse each word in the following:—
   (*a*.) Yours faithfully.
   (*b*.) 'Sweet lord, you play me false.'
   (*c*.) 'Far from the madding crowd's ignoble strife.'
2. What is meant by interrogative adverbs? Give examples.
3. The suffix *ly* forms certain words into adverbs, others into adjectives: give examples.

Geography.

1. Draw a full map of France. Insert the lines of latitude and longitude.
2. Trace minutely the course of the Rhine, mentioning in order its tributaries and the towns on its banks, and describing the character of the country through which it flows.

History.

1. Write down a list of our sovereigns from Alfred to Edgar, with dates.
2. What sovereigns reigned between Henry I. and Richard II.? Give their dates.
3. Mention the names and dates of sovereigns who sat on the throne between 1660 and 1760.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Geraldine*.

Write, in small hand, as a specimen of copy-setting, *The Programme of Proceedings*.

Composition.

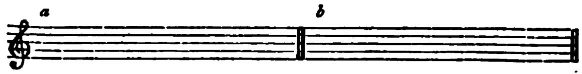
Write from memory the substance of the passage read to you by the Inspector.

Music.

A quarter of an hour allowed for this paper.

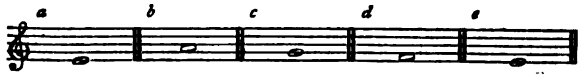
1. Write in *a* the scale of D (*Re*), and in *b* the scale of B♭ (*Se*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

a *b*



2. Place its third below *a*, its fifth below *b*, its fourth above *c*, its fifth above *d*, and its octave below *e*.

a *b* *c* *d* *e*



3. How many semiquavers are equal (in length) to one semibreve?
   How many quavers are equal (in length) to one minim?
   How many crotchets are equal (in length) to one dotted minim?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

		£	s.	d.
1.	£6⅜ =	6	7	6
	£19⅚ =	19	16	8
	£21⅓ =	21	6	8
	£5·75 = £5¾ =	5	15	0
	£14·125 = £14⅛ =	14	2	6
		67	8	4 Ans.

2. $1\frac{3}{8}$ oz. cost £$6\frac{1}{8}$
   1 oz. ,, £$6\frac{1}{8} \div 1\frac{3}{8}$
   $\therefore 5\frac{7}{8}$ oz. ,, £$\frac{31}{8} \times \frac{47}{8} \times \frac{8}{8}$
   i.e., £$\frac{1457}{64}$ = £22 15s. 3⅗d. Ans.

3. $\dfrac{\frac{3}{14}\text{ gui.}}{£1} = \dfrac{3 \times 21}{14 \times 20}\text{ s.} = \frac{9}{40} = \cdot225.$ Ans.

4. (*a*) $\frac{19}{33} = \frac{6\cdot3}{11} = \cdot\dot{5}\dot{7}$

(*b*)

```
         ·00756 122
             77·482
         ----------
          1512 244
        60489 76
       302448 8
      5292854
     5292854
     -----------
     ·58585844804
(a) = ·5757575757575...
```

∴ (*a*) is less than (*b*) by ·0101008722824 Ans.

5. In this sum the one gets one share and the other three shares; or £4 5s. 8d. is to be divided into four parts, one of which parts goes to one, and three to the other.

¼ of £4 5s. 8d. = £1 1s. 5d.
∴ ¾ ,, ,, = £3 4s. 3d. Ans.

FEMALES.

1. £365 − 365 times 8d. = £365 − £12 3s. 4d.
   = £352 16s. 8d. of expenditure.
   ∴ £500 − £352 16s. 8d. = £147 3s. 4d. Ans.

2. $\left.\begin{array}{l}40\text{ cwt.} : 257\text{ cwt.}\\ 6\text{ mls.} : 17\text{ mls.}\end{array}\right\} :: 10\text{s.} : \text{price of carriage.}$

   $\dfrac{10\text{s.} \times 257 \times 17}{40 \times 6} = £\dfrac{4369}{480} = £9\ 2\text{s. }0\tfrac{1}{4}\text{d.}$ Ans.

3. 14 lbs. 3⅜ oz. = 171⅜ oz.
   ∴ the price of 1 oz. = £514 4s. ÷ $\frac{857}{5}$

```
              5
857) 2571 0 (£3.  Ans.
     2571
```

4. 1 cwt. 2 qrs. 5 lbs. × 7 = 310,016 drams.
   5 oz. 7 drs. = 87 ,,

```
87)310016(3563  Allowances.
   261
    490
    435
     551
     522
      296
      261
       35 drs. = 2 ozs. 3 drs. Remaining.
```

Grammar.

1. (*a*) *Yours*—simple personal pro. 2nd pers. mas. or fem. plur. poss. used predicatively (of *servant?*).
   faithfully—adverb of manner, modifying the assertion '*I am* yours.'
   (*b*) *Sweet*—qual. adj. limiting *lord*.
   lord—com. noun, mas. sing. nom. of address, or vocative.
   you—simple pers. pron. 2nd pers. sing. in meaning, plural form, nom. subj. of *play*.
   play—intrans. verb, reg. indic. pres. indef. 2nd pers. plur. agr. with *you*.
   me—simple pers. pron. 3rd pers. sing. mas. or fem. obj. gov. by (*with*).
   false—adv. of manner, modif. *play*.
   (*c*) *Far*—adv. of deg. modif. the phrase '*from the madding*,' *etc*.
   from—prep. gov. obj. case *strife*.
   the—def. art. or disting. adj. limiting *crowd*.
   madding—qual. adj. limiting *crowd*.
   crowd's—com. collective noun, neut. sing. poss. attrib. *strife*.
   strife—abstr. noun, neut. sing. obj. gov. *from*.
2. Interrogative adverbs are those used in asking questions, and which at the same time modify the verb, as—*how*, interrogative of *manner*; *where*, of place; *when*, of *time*; *why*, of *cause*.

3. (*a*) The suffix *ly* forms adverbs (1) from *nouns*—day, dai*ly*; hour-*ly*, week-*ly* (2) from *adjectives*:—wise-*ly*, strong-*ly*; (3) from *participles*.—knowing-*ly*, loving-*ly*.

(*b*) Adjectives are formed from *nouns*—man *ly*, month-*ly*, heaven-*ly*, ghost-*ly*.

Geography.

1. The Rhine has its main source in Mt. St. Gothard, passes through the magnificent ravine of the Rheinwald, unites with a second head-stream, and flows through a beautiful valley to Lake Constance. After leaving this lake it forms the celebrated falls of *Schaffhausen*, and winding between lofty rocks is joined by the *Aar* and reaches *Basle*. At this town the river turns north, flowing through a rich open valley, and before it reaches Mentz it is joined by the *Neckar* from the Black Forest, and the *Mayne* from the Fichtelberg in the N.E. of Bavaria. After leaving Mentz it flows west for a short distance through an unbroken succession of picturesque scenery, and then turns N.W. until it enters the flats of Holland. Before this, however, it is joined by the *Moselle* from the Vosges Mts. on the left, and by the *Lahn*, *Ruhr*, and *Lippe*. Entering Holland, it immediately divides into two branches, the southern and larger called the *Waal*, which flows west, and joins the *Maas*; whilst the other, called the Rign (Rhine) flows N.W., and after dividing into several other branches, falls into the North Sea below *Leyden*. Just after entering Holland the Rhine throws off a branch called the *Yssel*, which falls into the Zuyder Zee; and half-way between Utrecht and Leyden the *Amstel* leaves the main stream, and flows into the estuary called the Y. The delta of the Rhine is the largest in Europe, and the length of the river is at least 800 miles. The towns on the main stream in order are:—*Constance, Basle, Strasbourg, Carlsruhe, Spires, Mannheim, Worms-Mentz, Coblentz, Bonn, Cologne, Nimeguen (Waal), Zutphen, (Yssel), Rotterdam, Utrecht, Amsterdam (Amstel)*.

History.

			A.D.
1.	Alfred	began to reign	871
	Edward (the Elder)	„ „	901
	Athelstan	„ „	925
	Edmund	„ „	941
	Edred	„ „	946
	Edwy	„ „	955
	Edgar	„ „	958

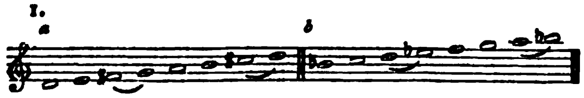
2. The sovereigns between Henry I. and Richard II. were—

		A.D.
Stephen	who began to reign	1135
Henry II.	„ „	1154
Richard I.	„ „	1189
John	„ „	1199
Henry III.	„ „	1216
Edward I.	„ „	1272
Edward II.	„ „	1307
Edward III.	„ „	1327

			A.D.
3.	Charles II.	began to reign	1660
	James II.	„ „	1685—dethroned 1688
	William III. } Mary II. }	„ „	1689
	Anne	„ „	1702
	George I.	„ „	1714
	George II.	„ „	1727
	George III.	„ „	1760

Music.

1.



2.

3. Sixteen.
Four.
Three.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Sixty-nine rifle competitors fired 30 shots apiece, and each man made an average of $1\frac{1}{3}$ centres. What was the percentage of centres to shots?

2. Find the interest on £527 11s. 9d. for $7\frac{1}{2}$ years at $3\frac{1}{8}$ per cent. per annum.

3. By selling eggs at 3 a penny I gain 5 per cent. What do I gain or lose per cent. by selling them at the rate of 25 for 6d.?

4. Divide £723 15s. among A, B, C, D, so that A, B, and C shall receive equal shares, and D $\frac{4}{5}$ of one of their shares.

5. Bought 236 yds. of lace at 7s. $10\frac{1}{2}$d. per yd.; sold $\frac{1}{4}$ of it at 10s. 6d. per yd., $\frac{1}{3}$ at 8s. 6d. per yd., and the remainder at 7s. per yd. What was the gain or loss per cent. on the whole outlay?

FEMALES.

1. Divide $9\frac{1}{8}$ by $\frac{2}{3}$ of 7; and $5205\frac{1}{3}$ by $\frac{7}{8}$ of 91.

2. If $25\frac{7}{8}$s. will pay for the carriage of 1 cwt. for $145\frac{1}{4}$ miles, how far may $6\frac{1}{2}$ cwt. be carried for the same money?

3. If £50 in 5 months gain £$2\frac{27}{128}$, what time will £$13\frac{1}{3}$ require to gain £$1\frac{1}{12}$?

4. Reduce 9 oz. $2\frac{3}{4}$ drs. to the fraction of a pound avoirdupois.

Grammar.

1. Point out and parse all the pronouns and prepositions in the following:—

> 'And never yet, since high in Paradise
> O'er the four rivers the first roses blew,
> Came purer pleasure into mortal kind
> Than lived thro' her who in that perilous hour
> Put hand to hand beneath her husband's heart
> And felt him *hers* again.'

(*a*) What are the analogous forms to 'hers,' derived from *thou, you, they*? and how does the use of these forms (hers, etc., etc.) differ from that of *her, thy, your, their*?

(*b*) Point out the principal sentence in the above, and analyse it.

2. Explain the terms—Syntax, subject, predicate, complex sentence, subordinate sentence.

Geography.

1. Draw a full map of our possessions in South Africa. Insert the lines of latitude and longitude, and explain how they are useful in drawing a map.

2. Give notes of a lesson on 'The Productions and Trade of Hindostan.'

SECOND PAPER.

One hour allowed for Females, two hours and a half allowed for Males.

History.

1. How came there to be Roman legions in Britain? When and why did they leave it?

2. What was Danegeld? Tell its object and effect.

3. In what way did Edward III. and Henry IV. respectively obtain the throne?

Penmanship.

Write in large hand, as a specimen of copy-setting, the word *Geraldine*.

Write in small hand, as a specimen of copy-setting, *The Programme of Proceedings*.

Composition.

Write full notes of a lesson on 'Malt and Hops.'

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. The angles at the base of an isosceles triangle are equal to each other, and if the equal sides be produced the angles on the other side of the base shall be equal.

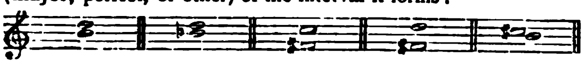
2. To bisect a given finite straight line—that is, to divide it into two equal parts.

3. Describe a circle which shall pass through two given points, and have its centre in a given straight line. Is this always possible?

Music.

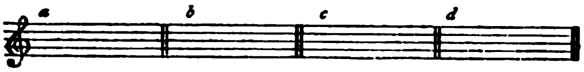
A quarter of an hour allowed for this paper.

1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms:—



2. Write in *a* two measures of common time, and in *b* two measures of triple time. Place the time signature before each.

3. Write in *a* the signature of G (*Sol*), in *b* that of F (*Fa*), in *c* that of E (*Mi*), and in *d* that of E♭ (*Me*).



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. 69 times 30 shots = 2070 shots.
69 times $1\frac{1}{3}$ centres = 92 centres.
2070 shots give 92 centres.
$\therefore$ 100 „ „ $92 \times \frac{100}{2070}$.
i.e., $\frac{920}{207} = \underline{4\frac{4}{9}}$ p.c. Ans.

2. Interest = £527 11s. 9d. $\times 7\frac{1}{2} \times \frac{3\frac{1}{6}}{100}$

£	s.	d.
527	11	9
		$7\frac{1}{2}$
263	15	$10\frac{1}{2}$
3693	2	3
3956	18	$1\frac{1}{2}$
		$3\frac{1}{6}$
395	13	$9\frac{3}{4}$
11870	14	$4\frac{1}{2}$
122.66	8	2·25
20		
13·28		
12		
3·3825		

$\therefore$ Interest = $\underline{£122\ 13s.\ 3·3825d.}$ Ans.

3. The price of 1 when 3 cost 1d. = $\frac{1}{3}$d.
„ „ 1 „ 25 „ 6d. = $\frac{6}{25}$d.
$\therefore$ selling the article at $\frac{1}{3}$d. brought $\frac{100}{100}$ of prime cost.
„ 1d. „ $\frac{300}{100}$ „
„ $\frac{1}{25}$d. „ $\frac{12\frac{3}{8}}{100}$ „
„ $\frac{6}{25}$d. „ $\frac{75\frac{5}{8}}{100}$ „
i.e., a loss of $\underline{24\frac{3}{8}}$ p.c. Ans.

4. A, B, C, and D get a total of $3\frac{3}{5}$ parts of £723 15s.

	£	s.	d.		£	s.	d.
A, B, or C's share =	723	15	0 $\div 3\frac{3}{5}$ =		3618	15	0
					6 × 3		
„				=	603	2	6
					3		
„				=	201	0	10
$\therefore$ D's share $\frac{3}{5}$ of £201 1s. 3d				=	£120	12	6

5.

			£	s.	d.
$\frac{1}{4}$ of 236 yds. = 59	at 10s. 6d.	=	30	19	6
$\frac{1}{3}$ „ = $78\frac{2}{3}$	„ 8s. 6d.	=	33	8	8
And $\therefore$ the remainder = $98\frac{1}{3}$	„ 7s. 0d.	=	34	8	4
	Total	=	98	16	6
	236 at 7s. $10\frac{1}{2}$d.	=	92	18	6
	$\therefore$ there is a gain		5	18	0

£92 18s. 6d. brings a gain of £5 18s.
$\therefore$ £100 „ $\frac{£5\ 18s.}{£92\ 18\frac{1}{2}s.} \times 100$
i.e., $£\frac{23600}{3717} = 6\frac{1298}{3717}$ p.c. Ans.

FEMALES.

1. (*a*) $9\frac{1}{6} \div \frac{1}{3}$ of $7 = \frac{55}{6} \times \frac{3}{7} = \underline{2\frac{13}{14}}$
(*b*) $5205\frac{1}{5} \div \frac{4}{5}$ of $91 = \frac{26026}{5} \times \frac{5}{364} = \frac{130130}{1820} = \underline{71\frac{1}{2}}$

2. 1 cwt. is carried $145\frac{1}{4}$ mls. for $25\frac{5}{7}$s.
$\therefore 6\frac{1}{2}$ „ „ $\frac{145\frac{1}{4}}{6\frac{1}{2}}$ „ „
i.e, $\frac{581}{26}$ mls. $= \underline{22\frac{9}{26}}$ mls. Ans.

3. $\left.\begin{array}{l} £13\frac{1}{3} : £50 \\ £2\frac{37}{156} : £1\frac{1}{12} \end{array}\right\}$ :: 5 mos. : time required.
$\frac{5 \text{ mos.} \times 150 \times 156}{40 \times 325} = 9$ mos. Ans.

4. $\frac{9 \text{ oz. } 2\frac{2}{7} \text{ drs.}}{1 \text{ lb.}} = \frac{146\frac{2}{7} \text{ drs.}}{256 \text{ drs.}} = \frac{1024}{1792} = \frac{4}{7}$ Ans.

Grammar.

1. *In*—prep. gov. obj. case *Paradise*.
o'er— „ „ „ *rivers*.
into— „ „ „ *kind*.
thro'— „ „ „ *her*.
her—personal pron. 3rd pers. sing. fem. obj. gov. by *thro'*.
who—simple rel. pron. referring to *her*. 3rd pers. sing. fem. nom. subj. of *put*.
in—prep. gov. obj. case *hour*.
to— „ „ „ *hand*.
beneath—prep. gov. obj. case *heart*.
her—pronominal poss. adj. limiting *husband*.
him—pers. pron. 3rd pers. sing. mas. obj. gov. by *felt*.
hers—pers. pron. 3rd pers. sing. fem. poss. case. used predicatively of *husband*.

(*a*) The forms of *thou*, *you*, and *they*, analogous to '*hers*,' are *thine*, *yours*, and *theirs*. These forms differ from *thy*, *your*, and *their* (which are used attributively), in being used without an expressed noun and only in the predicate of the sentence. *Thin*· is sometimes used in poetry for *thy* before a word beginning with a vowel.

(*b*) The principal sentence is 'and never yet came purer pleasure into mortal kind.'

Pleasure	... ...	simple subject.
purer	... ...	enlargement of subject.
came	... ...	incomplete predicate.
into mortal kind		completion of pred.
never yet	... ...	extension of pred. (*time*).

2. *Syntax* (*syn*, together, *taxis* arrangement) is the proper arrangement and connection of words in a sentence.

The *subject* denotes that which we speak about, and is always in the nominative to some verb.

The *predicate* is that which denotes what is said about the subject.

Complex, when applied to a sentence means that the sentence is one which, besides a principal subject and predicate, contains one or more subordinate clauses which have subjects and predicates of their own.

A *sentence* is a collection of words so arranged as to make complete sense.

A *subordinate sentence* forms a dependent part of a principal sentence, just as if it were an ordinary substantive, adjective, or adverb.

Geography.

1. The lines of latitude and longitude are useful in fixing the positions of places exactly as they are on the earth itself. They form, in fact, a complete set of guiding lines for drawing a correct representation of parts of the earth.

2. Notes on the 'Productions and Trade of Hindostan.'

PRODUCTIONS (*a*) *Vegetation*—of forest trees, teak used for ship-building, rivals the oak—of fruit trees, the various species of palms—rice, forming staple article of food is the chief grain cultivated—but wheat, barley, millet and maize also raised—besides sugar-cane, mulberry-tree, cotton, indigo, pepper—tea plant, which grows wild in Assam, has lately been carefully attended to—that valuable plant 'Cinchona' is successfully grown in the high-grounds—and opium, of which the government has a monopoly, grows chiefly in Bengal.

(*b*) *Animals*—the buffalo, camel, and elephant, are domesticated—Hindoo cattle have a hunch on the shoulders, and sheep have hair instead of wool—the cashmere goat, noted for its fine wool, the silkworm, and lac insect are largely reared—of wild animals, the leopard is frequently hunted—the lion, seen only among the northern mountains—the Bengal tiger, and the rhinoceros, are noteworthy.

(*c*) *Minerals* comprise iron, copper, tin, gold, and coal. Diamonds are found in several districts, the most valuable being those of Orissa and Golconda.

TRADE very extensively carried on with Britain, China, Japan, France, and Australasia—opium exported to China and Japan—indigo, silk, and tea to France and Great Britain—silk and saltpetre to America— principal part of exports is conveyed to the United Kingdom—one-half of all imports comes from United Kingdom—these consist chiefly of cotton goods and yarn, railway materials, and various metals—opium exchanged with China for tea and silk, which are then sent to England—thus Britain is implicated in this diabolical traffic—internal trade has been vastly developed by means of railways and canals.

History.

1. Julius Cæsar having conquered Gaul was led either from curiosity or ambition to invade Britain, B.C. 55, with two legions, and again in 54, with five legions. Cæsar having forced the Britons to yield, left the island, and not till A.D. 43, did Roman legions again visit Britain. From that year till 78, the Romans could not make head against the islanders, but the arrival of Julius Agricola led to the subjugation and partial civilisation of the Britons (78-85). In A.D. 410, under the Emperor Honorius, the attacks of barbarians on Italy led to the withdrawal of the Roman legions from Britain for the defence of the empire.

2. Soon after the accession of Ethelred, the Unready, the Danes renewed their attacks, and he very foolishly *bought* them off instead of fighting them. This led to the imposition of a tax called *Danegeld* (Dane-money) to pay the shoals of Danish invaders whom Ethelred's shameful policy attracted to the island.

3. In 1327, a parliament summoned by Queen Isabella, formally deposed Edward II., and the young prince Edward, a lad of fourteen, became king as Edward III. In the same year his father was murdered by ruffians in the pay of Isabella's paramour, Mortimer.

Henry Bolingbroke, son of John of Gaunt, Duke of Lancaster, was banished by Richard II., and during his banishment his father died. The Duke's estates were confiscated, and Henry, taking advantage of the king's absence in Ireland, came over with a number of followers to claim his inheritance. The people flocked to Henry, Richard was formally deposed for misgovernment, and Bolingbroke was declared king by the title of Henry IV. (1399).

Composition.

NOTES OF A LESSON ON MALT AND HOPS.

MALT.—*Definition.*—Malt is grain, usually barley, which has become sweet and more soluble in water from the conversion of its starch into sugar, by forcing the grain to germinate or sprout to a certain extent and then stopping the process by the application of heat.

Malting—barley steeped in cold water for at least forty hours—grain imbibes moisture and increases in bulk—carbonic acid emitted—part of grain dissolved in water which is exceedingly bitter.

Water drained off and grain turned out to *malt floor* and formed into a heap called a *couch*—remains thus for twenty-six hours—turned repeatedly every twelve hours or so, and gradually spread out to a depth of six inches—in *couch*, it imbibes oxygen from atmosphere, and converts it into carbonic acid—at this time grain again becomes moist—sends out an agreeable odour—at this moistening (called *sweating*) roots begin to appear—then in a day or so the future stem, *acrospire*, is seen to lengthen—now mealy part of grain undergoes a considerable change—the glutinous matter is taken up—the colour of the kernel becomes white, and texture so loose as to crumble to powder between the fingers—the object of malting is to produce this change—when accomplished, the process is stopped by drying the malt upon the kiln—malt subsequently cleared to separate the rootlets—from malt are brewed and distilled spirits, ale, porter.

HOPS.—Climbing plants extensively cultivated for their flowers or seed-vessels, which give flavour and permanence to beer, by being boiled with the wort in brewing.

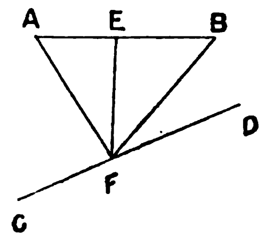
Where grown.—Most extensive plantations in Kent, Sussex, and Herefordshire—also in Worcestershire, Wilts, Hants, Gloucestershire, Surrey—those of Kent and Sussex, the best in the world.

Cultivation.—Requires a very rich soil—young plants raised in beds, sometimes from seed, more usually from shoots got at bottom of stems of old plants—young plants placed in groups of three, about six inches apart—when *bines* appear a stick three or four feet is stuck in the middle of the three, and the bines tied till they lay hold on and twine round it—generally there are no hops got the first year—in second year plants carefully examined and staked with poles twelve feet long—in September the flower containing the seed assumes a fine straw colour turning to a brown—picking then commences—hops dried on hair-cloth in a kiln—undergo a slight heating in heaps—and then bagged and stored till wanted for sale.

Uses.—Besides flavouring beer they are used in medicine—brown dye got from leaves—the bines have been made into paper and cloth—prunings useful as provender for cattle—spent hops may be used as a manure.

Euclid.

1. Prop. 5, Bk. I.
2. Prop. 10, Bk. I.
3. Let A and B be the given points, and CD the given straight line. Join AB, and bisect it in E. From E draw EF perpendicular to AB, and meeting CD in F. Join AF, BF.



Because AE=EB and EF is common to the two triangles AEF, BEF, and the angles AEF, BEF, are right angles, then (by I. 4) the base AF=BF, and ∴ the circle described from the centre F at the distance FA, or FB, will pass through the points A and B. Q.E.F.

This problem is impossible when the line joining the two given points is perpendicular to the given line, because in such a case the perpendicular from the point of bisection could not meet the given line.

Music.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May, 1878*; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a-half allowed.

Arithmetic.

MALES.

1. A boy earns 18s. a week, spends only 14s. 6d., gives his mother $\frac{4}{7}$ of his savings to put by for him, and the remainder for her own use. What percentage of his income does he put by; and what percentage goes to his mother for her own use?

2. If £33 6s. 8d. produce £5 8s. 6¾d. in 1½ years, what sum may be expected from £520 17s. 11d. dealt with in the same way for 2½ years, and what is the rate per cent. per annum of profit?

3. I bought 15 gallons of a liqueur for £27, and retailed it at 5s. a pint; what was the gain per cent., and wh[illegible] the whole?

4. What income will be derived from shares [illegible]ng 7 per cent. purchased (at par) with the sum accruing from the sale of £629 14s. 5d. of stock at 92¾ per cent.?

5. A has 50 chests of tea, which cost £22 10s. per chest; he barters with B, at an estimated profit of 20 per cent., for a quantity of mahogany at £30 a ton. The mahogany depreciating in value during storage, A loses on it 1s. 6d. per cwt. What is his net gain by the transaction?

FEMALES.

1. If ·375 of a ship be worth £3740; what is the worth of the whole?

2. From 270·2 take 76·4075, and divide 721·17562 by 2·257432.

3. Reduce 2 gal. 1 qt. beer to the dec. of a barrel, and find the value of ·046875 of a lb. avoirdupois.

4. Divide 3·$\dot{5}$ by ·$\dot{2}\dot{4}$, and multiply 4·7$\dot{2}$ by 3·6,

Grammar.

1. 'It is great sin to swear unto a sin,
But greater sin to keep a sinful oath.
Who can be bound by any solemn vow
To do a murderous deed, to rob a man,
To reave the orphan of his patrimony,
And have no other reason for this wrong
But that he was bound by a solemn oath?'
—KING HENRY VI.

(*a*.) Parse all the words in the last line.

(*b*.) Analyse the two sentences contained in the last two lines, supplying any words that are required to make the analysis complete.

N.B. Take care to point out the character of each sentence.

(*c*.) When is the infinitive mood used without being preceded by the word *to*? Give examples of this from the above passage, and mention others that occur to you.

2. Write the subject-matter of a lesson on either of the following:—Mood, Tense.

3. Give the Latin prepositions that mean under, with, across, out of.

Geography.

1. Draw a full map of our possessions in South Africa. Insert the lines of latitude and longitude, and explain how they are useful in drawing a map.

2. Give notes of a lesson on 'The Caspian Sea.'

SECOND PAPER

One hour allowed for Females
Two hours and a-half allowed for Males.

History.

1. Give the names and dates of sovereigns of the House of Tudor and show the relationship between them.

2. Do you consider our Stuart sovereigns to have been fortunate or unfortunate? Give your reasons.

3. During the reign of George III. a large foreign possession was lost to England. Explain the event and give some particulars.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Geraldine.*

Write, in small hand, as a specimen of copy-setting, *The Programme of Proceedings.*

Composition.

Write from memo y the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used]

1. If two triangles have two sides of the one equal to two sides of the other, each to each, but the base of one greater than the base of the other; the angle contained by the sides of the one which has the greater base shall be greater than the angle contained by the sides, equal to them, of the other.

2. The opposite sides and angles of a parallelogram are equal to one another and the diameter bisects it, that is, divides it into two equal parts.

3. If in the sides of a square, at equal distances from the four angles, four points be taken, one in each side, the figure formed by joining them will also be a square.

Algebra.

1. Explain the terms *coefficient, expression, factor, index, greatest common measure, identical equation.*

Find the coefficiency of x^3 in the product of ax^4-bx^3+cx-d and px^3-qx+r.

2. Reduce $\frac{x^2-5x+6}{x^2+2x-8}$ and $\frac{6+x-x^2}{8+6x+x^2}$ to lowest terms, and then add them together.

3. Solve the equations:—

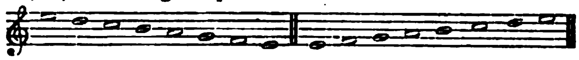
(1.) $\frac{1}{4}(x-\frac{1}{2})-\frac{1}{5}(\frac{2}{3}-x)=1\frac{13}{30}$.

(2.) $\frac{7x+1}{x-1}=\frac{35}{9}\left(\frac{x+4}{x+2}\right)+\frac{20}{9}$.

Music.

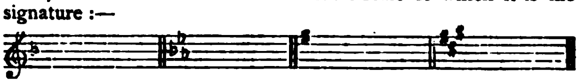
A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of E (*Mi*). Marking the places of the semitones.



2. Write a measure, of notes and rests, in each of the kinds of time indicated by the following signatures:—

3. Write over each of the following the nam f the major scale, and under each that of the minor scale of which it is the signature:—



ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. (*a*) $\frac{3}{7}$ of (18s. — 14s. 6d.) = 3s. 6d. × $\frac{3}{7}$ = 1s. 6d. put by.
(*b*) ∴ he gives 2s. to his mother for her own use.
(*a*) 1s. 6d. = $\frac{1}{12}$ of 18s., *i.e.*, $\frac{100}{12}$ or $8\frac{1}{3}$ p. c. of whole.
(*b*) 2s. 0d. = $\frac{1}{9}$ of 18s., „ $\frac{100}{9}$ „ $11\frac{1}{9}$ „ „

2. (*a*) £33 6s. 8d. : £520 17s. 11d.
or or
8,000d. : 125,015d.
$1\frac{1}{4}$ yr. : $2\frac{1}{4}$ yrs. } :: £5 8s. $6\frac{2}{3}$d. or $\frac{3908}{3}$d. : Int.
$\frac{3908}{3}$d. × $\frac{125015}{8000}$ × $\frac{8}{5}$ = 36641·896 d. =
£152 13s. 5·8965d.

(*b*) £$33\frac{1}{3}$: £100 :: £5 8s. $6\frac{2}{3}$d. : rate p. c.
$1\frac{1}{4}$ yr. : 1 yr.
$\frac{£16\ 5s.\ 8d.}{3}$ × $\frac{300}{100}$ × $\frac{4}{5}$ = $\frac{£65\ 2s.\ 8d.}{5}$ =
£13 0s. $6\frac{2}{3}$d. Ans.

3. 15 galls. @ 5s. a pt. = 5s. × 120 = £30
Cost price = £27
(*a*) ∴ Gain on whole = £ 3
(*b*) Prime cost £27 brings a profit of £3
„ £100 „ „ £3 × $\frac{100}{27}$
i.e. $11\frac{1}{9}$ p. c. Ans.

4. (*a*) Sum accruing from sale of sto k = £629 14s. 5d. × $\frac{92\frac{3}{8}}{100}$

(*b*) ∴ Income = £629 14s. 5d. × $\frac{92\frac{3}{8}}{100}$ × $\frac{7}{100}$
= 151133d. × $\frac{739}{800}$ × $\frac{7}{100}$
= $\frac{78181 \cdot 1009}{8}$d.
= 9772·6376125d.
i.e. = £40 14s. 4·6376125d. Ans.

5. 50 chests at £22 10s. = £$22\frac{1}{2}$ × 50 = £1125
$\frac{20}{100}$ of £1,125 = 225
∴ the value of the mahogany = 1350
and weight „ = $\frac{1350}{30}$ = 45 tons
Loss on 45 tons at 1s. 6d. per cwt. = $1\frac{1}{2}$s. × 900 = 1350s. = £67 10s.;
And so A.'s net gain = (£225 − £67 10s.) = £157 10s. Ans.

FEMALES.

1. ·375 = $\frac{375}{1000}$ or $\frac{3}{8}$; ∴ the value of whole ship = £$\frac{3740 \times 8}{3}$ = £$\frac{29920}{3}$ = £9973 6s. 8d. Ans.

(a)

2. 270·2
   76·4075
   193·7925

(b)

2·257432)721·17562(319·46......
677 2296
4394602
2257432
21371700
20316888
10548120
9029728
....

3. (a) $\frac{2 \text{ galls. } 1 \text{ qt.}}{36 \text{ galls.}} = \frac{9 \text{ qts.}}{144} = \frac{\cdot 75}{12} = \underline{\cdot 0625}$

(b) $\cdot 046875$ lbs. $= \cdot 75$ oz. $= \underline{12 \text{ drs.}}$

4. (a) $3\cdot\dot{5} \div \cdot\dot{2}\dot{4} = \frac{32}{9} \times \frac{33}{8} = \frac{44}{3} = \underline{14\cdot\dot{6}}$

(b) $4\cdot\dot{7}\dot{2} \times 3\cdot\dot{6} = 4\cdot\dot{7}\dot{2} \times 3\frac{2}{3} = \frac{51\cdot 94}{3} = \underline{17\cdot 3148}$

Grammar.

1. (a) *But*—prep. (= except) gov. objective case (*reason*); or whole of no. clause, '*that he was bound*,' etc.
that—final conj. introducing noun clause.
he—pers. pron. 3rd pers. sing. mas. nom. subj. of *was*.
was—irreg. subst. verb, *am*, *was*, *been*, forming with *bound*—(complete part of irreg. trans. v., *bind*, *bound*, *bound*), pass. voice, indic. past indef., 3rd per. sing., agr. with subj. *he*.
by—prep. gov. obj. case *oath*, (connecting the notions of *binding* and *oath*).
a—indef. article, or adj. limiting *oath*.
solemn—qual. adj. limiting *oath*.
oath—abstr. noun, neut., sing., obj., gov. by *by*.

(b)

Sentences.	Kind.	Subject.	Predicate.	Completion of predicate.	Connective.
(1) 'And (*Who can*) have no other reason for this wrong but (*this reason*).'	Principal	(*who*)	(*can*) have	no other reason (object) for it but (*this reason*)	And
(2) 'That he was bound by a solemn oath.'	Subord. noun; in apposition with (*reason*)	he	was bound	by a solemn oath	that

(c) The infinitive mood without the word *to* is used after the auxiliaries *may*, *do*, *can*, *must*, *shall*, *will*, and after these principal verbs *bid*, *make*, *see*, *hear*, *let*, *full*, *need*, *dare* (intrans.), *will*.

(a) Examples from given passages (1), 'Who can (*to*) *be bound*' (2) (*who can*) (*to*) *have* no other reason.

(b) Other examples: 'Men *may come*, and men *may go*;' '*I dare do* all that *may become* a man;' '*Bid me* discourse, I will *enchant* thy ear;' 'Need we *fear* discovery.'

2. (1) MOOD (*modus*, manner) is that inflexion which a verb undergoes to show the *mode* or manner in which the action or state denoted by the verb is presented to our minds. (2) When we make a direct assertion, or ask a question, we use the *Indicative* (*indicare*, to point out) Mood. (3) When we order anything to be done, we use the Imperative (*imperare*, to command). (4) When we wish to express a conditional or uncertain statement, we use the Subjunctive (*subjungere*, to subjoin); and (5) when the notion expressed by the verb is used without any reference to an agent, we employ the Infinitive (*infinitus*, unbounded) Mood.

Examples of all the Moods to be given orally, derived from the pupils, written on blackboard, and searched for in reading books. Examples always to precede definitions.

TENSE (*tempus*, time) is that form of the verb which indicates the *time* of the action or state, and the *completeness*, or incompleteness of that action or state.

Time consists of three divisions, *Past*, *Present*, and *Future*, and as these may be either perfect, imperfect, or indefinite; from these three spring *nine* kinds of tense:—

Present { Perfect—*I have written, I have been told.*
Imperfect—*I am writing, I am being told.*
Indefinite—*I write, I am told.*

Past. { Perfect—*I had written, I had been told.*
Imperfect—*I was writing, I was being told.*
Indefinite—*I wrote, I was told.*

Future. { Perfect—*I shall have written, I shall have been told.*
Imperfect—*I shall be writing, I shall be being told.*
Indefinite—*I shall write, I shall be told.*

3. The Latin preposition for *under* is sub or subs (suc—suf—sur—sus—so—*as in sojourn*)
'*with*' is cum (con—com—col—cor—co)
'*across*' is trans or tra
'*out of*' is ex (ec—ef—e—)

Geography.

1. *See same question answered under Geography of 'Second Year.'*

2. Notes on the 'CASPIAN SEA.'

Position—Lies on south-eastern boundary of Europe—Caucasia on western—Persia on southern shore—Russia on north and east.

Character—a vast salt-water lake—largest strictly inland expanse of water in the world—called a 'sea' by the ancients who thought it a part of the Northern Ocean—remarkable from its surface being below the general level of the waters of the globe, and having no outlet.

Extent—640 miles long—from 100 to 200 miles broad—covers an area of from 130,000 to 180,000 sq. miles.

Feeders—principal rivers running into it—the *Volga*, (2,200 miles), longest of European rivers—the *Ural* (1,150 miles), *Terek* (300 miles), *Kour* (550 miles), and the *Atrek*.

How surplus water is got rid of—supply of rain and river water seems to be exactly equal to the amount evaporated—were this not the case an alteration of level would be the result—present level remains unchanged.

Note—the Caspian Sea *has no tides*—waters are moderately salt—it is shallow—stormy—of difficult navigation—and has a few indifferent ports.

History.

1. The following list shows the Tudor dynasty with the relation of the successor to the immediate predecessor:—

Henry VII. first of the House of Tudor,				1485—1509
Henry VIII. (son) reigned from			...	1509—1547
Edward VI. (son)	"	"	...	1547—1553
Mary (sister)	"	"	...	1553—1558
Elizabeth (sister)	"	"	...	1558—1603.

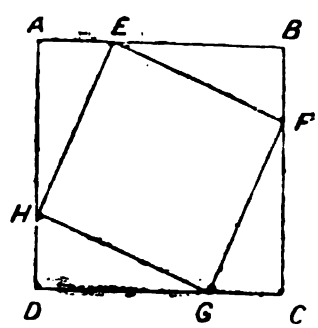
2. The following facts connected with the history of the Stuarts shew them to have been a very unfortunate race, namely:—Charles I. was executed 1649, and his son Charles II. was a fugitive for eleven years, from 1649 to 1660. James II. was deposed 1687, and his male descendants were disinherited.

3. During the reign of George III. the American Colonies refused to pay taxes to the home Government, because they did not send representatives to Parliament. The British Government endeavoured by force of arms to compel them to yield, but the Americans, under the command of George Washington, maintained a war for seven years (1776—83), during which many battles were fought with various success. At length the capitulation of the British first at Saratoga and then at Yorktown compelled the home Government to come to terms, and the treaty was drawn up 1783, by which the independence of the United States was acknowledged.

Euclid.

1. Prop. 25, Bk. I.
2. Prop. 36, Bk. I.
3. Let E, F, G, H, be points taken equally distant from A, B, C, D, the angles of the square ABCD: then the figure EFGH will be a square.

Because AE is equal to BF and AH obviously equal to BE; and the angles at A and B right angles then (by I. 4) the triangles AEH, BFE are equal in every respect. Wherefore EH is equal to EF. In the same way it may be shown that EF = FG, FG = GH, and GH = EH, and therefore the figure EFGH is equilateral.



Again the triangles AEH, BFE being equal in every respect, the angle BFE = angle AEH. ∴ the angles AEH, BEF are equal to the angles BFE, AEH. Now it is evident that

BFE, BEF being equal to a right angle (I. 32) AEH, BEF must be equal to a right angle, and therefore the remaining angle HEF being the supplement of two right angles must be a right angle. In the same manner the angles at F, G, H, are right angles, and therefore the figure EFGH is rectangular. It is therefore a square—Q.E.D.

Algebra.

1. *Co-efficient* is the number, whether whole or fractional, which is placed before a quantity as a multiplier, as 5 in $5a$, $5a$ in $5ax$. These may be both *literal* and *numerical* co-efficients.

An *Expression* is any collection of algebraical symbols. When the quantity consists of one *term* as b, bx, it is *simple*, or a monomial; of two terms, as $a+x$ it is a *binomial*; of three as, $ay+ax+by$, it is a *trinomial*; of more than three, it is a *multinomial*. When a quantity consists of the product of two or more quantities, each of the latter is called a *factor*; thus, in the expression axy there are three factors, a, x, and y.

An *Index* is a number placed above a quantity to express the power of that quantity; it is also called the *exponent*; thus, 3 is the index of a in a^3.

The *greatest common measure* of two or more quantities is the greatest number or quantity that will divide each of them without a remainder, thus ax is the G. C. M. of axy, $2abxs$, $3acx$.

An *identical equation* is one in which the one side is identical with the other, thus $ab+bx^2=ab+bx^2$, or $(a-b)(a+b)=a^2-b^2$. It has been advised that *three* lines should be used in place of *two* when the one expression is identically equivalent to the other, thus $(a+x)^2\equiv a^2+2ax+x^2$.

$$\begin{array}{r}
ax^4-bx^3+cx-d \\
\underline{px^2-qx+r} \\
apx^6-bpx^5+pcx^3-pdx^2 \\
-aqx^5+bqx^4-cqx^2+dqx \\
+arx^4-brx^3+crx-dr \\
\hline
apx^6-(aq+bp)x^5+(ar+bq)x^4+(pc-br)x^3+(cq-pd)x^2+(cr+dq)x-dr
\end{array}$$

$\therefore$ the coefficiency of x^3 is $\underline{(pc-br)}$ Ans.

2. (a) $\dfrac{x^2-5x+6}{x^2+2x-8}=\dfrac{(x-2)(x-3)}{(x-2)(x+4)}=\dfrac{x-3}{x+4}$

(b) $\dfrac{6+x-x^2}{8+6x+x^2}=\dfrac{(3-x)(2+x)}{(x+4)(2+x)}=\dfrac{3-x}{x+4}$

$\therefore$ the sum of (a) and (b) $=\underline{0}$ Ans.

3. (1) $\frac{5}{6}(x-\frac{1}{2})-\frac{7}{6}(\frac{2}{3}-x)=\frac{43}{6}$

Clearing of fractions $30x-15-28+42x=301$

$72x=301+43=344$

$\therefore x=\underline{4\frac{7}{9}}$ Ans.

(2) $\dfrac{7x+1}{x-1}=\frac{35}{9}\left(\dfrac{x+4}{x+2}\right)+\frac{28}{9}$

$\dfrac{63+9}{x-1}=\dfrac{35x+140+28x+56}{x+2}=\dfrac{63x+196}{x+2}$

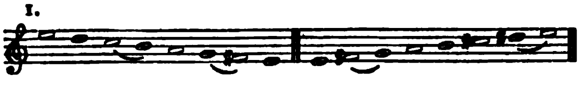
$\therefore 63x^2+135x+18=63x^2+133x-196$

$2x=-214$

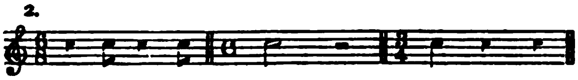
$\underline{x}=-107$ Ans.

Music.

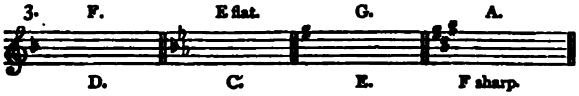
1.



2.



3.



FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May, 1878*; **and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. Sold goods for £225 10s. 0d. with a gain of $12\frac{1}{2}$ per cent., how much per cent. would have been gained or lost by selling them for £187 10s. 0d.?

2. What sum must I have invested (neglecting fractions of a penny) in $3\frac{1}{2}$ per cent. stock at $89\frac{1}{4}$, in order that, spending daily 15s. 6d. out of my income, I may lay by in a year (365 days) £123·55?

3. If the loss per cent. in selling 50 copies of a book at 7s. 6d. per copy, 80 at 4s., and the remainder of the edition for £12, was $35\frac{15}{17}$; what was the cost of publishing the book?

4. By how much greater or less than £25 5s. 6d. will be the interest on £321·76875 for 2 years 5 months at $3\frac{1}{4}$ per cent. per annum?

5. What is the length of one of the four equal sides of a rectangular park containing 98759·3476 square yards;

or, what fraction of a mile is the side of a similarly shaped park containing ·694 square mile?

FEMALES.

1. If I buy a yard of cloth for 14s. 6d. and sell it for 16s. 9d., what do I gain per cent.?

2. At what rate per cent. will £956 amount to £1314 10s. in $7\frac{1}{2}$ years at simple interest?

3. A young man received £210, which was $\frac{2}{3}$ of his elder brother's portion; now three times the elder brother's portion was half of the father's estate, how much was the estate worth?

4. Find the interest of £985 2s. 7d. for 5 years 127 days, at $5\frac{1}{2}$ per cent. per annum.

Grammar.

1. '*Let it be remembered, that to write, however* ably, merely to convince *those* who are already *convinced, displays but* the courage of a boaster.' COLERIDGE. *The Friend.*

(a) Analyse the above passage.

(b) Parse fully all the words in italics.

(c) What is meant by a finite verb, and what is the nature of the infinitive mood? Illustrate from the above passage.

2. In what respects is the English alphabet incomplete?

Geography.

1. Give notes of a lesson to an advanced class on 'The Lines of Latitude and Longitude, as shown on a globe, their meaning and their usefulness.'

Draw a map of North America, with the lines inserted, and refer to this map at each point of the lesson.

2. What is a Coral Island? Where are such islands found?

SECOND PAPER.

One hour allowed for Females.

Two hours and a half allowed for Males.

History.

1. What English sovereigns have died a violent death? Distinguish between accident and design, and give dates of the events.

2. When and how did the conquest of Ireland begin, and under what circumstances was the legislative union with that country effected?

3. Mention what you consider to be the most important events which have happened so far in the reign of the Queen.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Geraldine.*

Write, in small hand, as a specimen of copy-setting, *The Programme of the Proceedings.*

Composition.

Write a short essay on *Colonization.*

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. ABCD is a parallelogram; through A draw any line, and show that the distance of C from this line is equal to the sum or difference of the distances of D and B, according as the line passes without or within the parallelogram.

2. If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by the parts.

3. To describe a square that shall be equal to a given rectilineal figure.

Algebra.

1. Show that $3(y-x)(y+x)(5y^2-8xy+5x^2)=(x-2y)^4-(2x-y)^4$.

2. Find a number such that, whether it be divided into two or into three equal parts, the continued products of the parts shall be the same.

3. Solve the equations:—

$$(1)\ \begin{cases}10x - 11y + 12 = 0 \\ 13x - 14y + 11\cdot7 = 0.\end{cases}$$

$$(2)\ \frac{7x}{3} + \frac{3-x}{2x} = 20\tfrac{2}{3}.$$

Mensuration.

1. 'The area of a triangle is half the product of the base and the altitude.' How would you prove this to a class of boys who have read the first book of Euclid?

2. An oblong grass plot 120 feet by 60 is to be levelled at £6 1s. per square chain, and a lawn tennis court 78 feet by 36 is to be turfed within it at 4d. per square yard. What will be the cost?

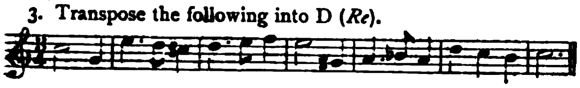
Music.

A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of E (*Mi*) minor, in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.

2. Write, under each of the following pairs of notes, the name and quality (major, perfect, diminished, or other) of the interval it forms:—

3. Transpose the following into D (*Re*).



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. What was sold at £225½ brought $\frac{112\frac{3}{4}}{100}$ of prime cost.

„ £1 „ $\frac{451}{400} \div \frac{451}{2}$ „

„ £187½ „ $\frac{451}{400} \times \frac{2}{451} \times \frac{375}{2}$ „

i.e., $\frac{375}{400}$ „

i.e., $\frac{93\frac{3}{4}}{100}$ „

Which is ∴ a loss of 6¼ per cent. Ans.

2. 365 at 15s. 6d. = £282·875

The savings = 123·55

∴ total income must be £406·425

Now, £3½ is got from £89⅛

£1 „ $£\frac{713}{8} \div \frac{7}{2}$

∴ $£406\frac{17}{40}$ „ $£\frac{713}{8} \times \frac{2}{7} \times \frac{16257}{40}$

i.e., $£\frac{11591241}{1120}$

or £10349 6s. 5d.

3. (*a*)

	£	s.
50 copies at 7s. 6d. ea. =	18	15
80 „ 4s. 0d. „ =	16	0
And remaining sales =	12	0
∴ total price of edition =	46	15

(*b*) Now, since there was a loss of $35\frac{15}{29}$ p. c.

∴ £46¾ must have brought only $\frac{64\frac{14}{29}}{100}$ of publishing price,

which price must have been $£46\frac{3}{4} \times \frac{100}{64\frac{14}{29}} = £\frac{187}{4} \times \frac{2900}{1870}$

$= £\frac{290}{4}$

i.e., £72 10s.

4. Interest $= £\,321\cdot76875 \times 2\frac{5}{12} \times \frac{3\frac{1}{4}}{100}$

$= £\frac{321\cdot76875 \times 29 \times 13}{12 \times 100 \times 4}$

$= £\frac{1213\cdot0681875}{48}$

$= £\,25\cdot27225390625$

i.e., £25 5s. 5·3409375d.

and given sum is £25 5s. 6d.

∴ given sum is greater by 0·6590625d.

5. (*a*) The length of one side $= \sqrt{98759\cdot3476}$ sq. yds.

Taking square root.

	98759·3476 (314·26
3 × 3 =	9
	87
6,1 × 1 =	61
	2659
62,4 × 4 =	2496
	16334
628,2 × 2 =	12564
	377076
62846 × 6 =	377076

∴ each side = 314·26 yards.

(*b*) $.694 = \frac{625}{900} = \frac{25}{36}$ ∴ a side of park $= \sqrt{\frac{25}{36}}$ sq. ml.

i.e., the length of each side is ⅚ of a mile. Ans.

FEMALES.

1. 14½s. brings a profit 2¼s.

1 „ „ $\frac{9}{4} \div \frac{29}{2}$

∴ 100 „ „ $\frac{9}{4} \times \frac{2}{29} \times \frac{100}{1}$

i.e., $\frac{450}{29}$ or $15\frac{15}{29}$ per cent.

2. £1,314 10s. − £956 = £358 10s. of interest

$\left.\begin{array}{l}£956 : £100 \\ 7\tfrac{1}{2}\text{ yrs.} : 1\text{ yr.}\end{array}\right\} :: £358\tfrac{1}{2}$: rate per cent.

$£\frac{717}{2} \times \frac{100}{956} \times \frac{2}{15} = £5.$ Ans.

3. $\frac{3}{2}$ of £210 = elder brother's portion.

3 times ($\frac{3}{2}$ of £210) = half of father's estate.

∴ ($\frac{3}{2}$ of £210) × 3 × 2 = value of whole estate.

„ $= £\frac{210 \times 3 \times 3 \times 2}{2}$.

i.e., £1890. Ans.

4. Interest $= £985\text{ 2s. 7d} \times \frac{1952}{365} \times \frac{5\frac{1}{2}}{100}$

$= £985\frac{31}{240} \times \frac{1952}{365} \times \frac{11}{200}$

$= £\frac{236431 \times 1952 \times 11}{240 \times 365 \times 200} = £\frac{236431 \times 11 \times 61}{15 \times 36500} =$

$£\frac{158645201}{547500} = £289\text{ 15s. }3\frac{929}{9125}\text{d.}$

Grammar.

1 (*a*)

Sentence.	Subject.	Predicate.	Object.	Extension.	Connective.
(1) Let it be remembered (Principal)	(*you*)	let	it (*direct*) (*to*) be remembered (*complement*)		
(2) that to write, however ably, merely to convince those displays but the courage of a boaster [*Subord. noun sent. in apposition with* '*it*' in (1)]	to write .. to convince those	displays	the courage of a boaster	but (*deg.*)	that
(3) Who are already convinced. [*Adj. sent. to* '*those*' *in* (2)]	who	are convinced		already (*time*)	

(*b*) *let*—trans. verb, irreg. *let*, *let*, *let*, imper. 2nd pers. plur. agreeing with subj. (*you*).

it—pers. pron., 3rd pers. (having a forward reference to the clause '*that to write, etc.*.....*boaster*' neut. sing. obj. by *let*.

be—pres. indef. inf. of *am*, *was*, *been*, forming with *remembered*—complete part. of reg. trans. v. *to remember*—the pres. indef. infin. pass. voice. gov. in the infin. without the sign 'to' by *let*.

that—subordinate conj. introducing a noun sentence.
to write—pres. indef. infin. substantive form of the verb *to write*, intrans. irreg. *write*, *wrote*, *written*, subj. of *displays*.
however—adv. of degree modifying *ably*.
those—demonstr. pron. 3rd pers. plur. mas. or fem., referring to (*persons*) obj. gov. *to convince*.
convinced—complete part. of reg. verb *to convince*, forming with '*are*' pres. indef. indic. pass. voice.
displays—trans. verb, reg. indic. pres. indef. 3rd pers. sing., agreeing with subj. *to write*.
but—(= only) adv. modifying *displays*.

(*c*) The *finite* verb is that part of the verb which asserts definitely of its subject or nominative, the three finite moods being the indicative, the subjunctive, and the imperative.

The *infinitive* merely expresses the action or state of the verb without reference to person, number, or time. It cannot be attached to a subject to make an assertion, but it may be joined to a subject in dependent phrases, as '*Let it be remembered*.' It commonly has the force of a substantive, and may be used as the *subject* of a sentence, as, '*to write*, etc., *displays*, etc.'; or the *object* of another verb, as, '*to write to convince*.' As an *object* it is generally governed by certain prepositions (*to* and *but*)—' I cannot but *admire* him.' With 'let' it forms a kind of 1st and 3rd pers. to the imperative, as, 'Let it be remembered.'

(2). The English alphabet is incomplete in the following respects:

(*a*). It has only twenty-six symbols, four of which are superfluous, to represent more than forty sounds.
(*b*). Only eight of these symbols are sounded always the same.
(*c*). The same symbol represents a variety of sounds.
(*d*). And the same sound is represented in many ways.

Geography.

Notes on 'The lines of Latitude and Longitude, as shown a globe; their meaning and usefulness.'

Meaning—Examine a globe—lines are found drawn from top to bottom, and round it—the important one round the middle, named the *Equator*—8 lines parallel to that above and 8 below—all circles, getting smaller as they near the poles—*Explain why*—called parallels of latitude—show in degrees, minutes, seconds ('*division of circles' to be explained*), the distance of places reckoned in degrees, 1° to 90° from Equator—places above being in north latitude—places below in south latitude; look for these remarkable parallels, tropics of Cancer and Capricorn, Arctic and Antarctic circles (*these terms to be explained*).—Lines drawn from N. to S., called meridians (*why?*) all same size—all great circles—(*why?*) being all the same, a special one chosen to reckon from, called a '*first meridian*'—places reckoned at so many degrees, etc. E. or W. of first meridian, till they meet at 180°—the British choose for their first meridian, the one passing through Greenwich Observatory; the French, the one through Paris. Other countries, generally the one passing through the capital, (The *Knot*, geographical or nautical mile, to be explained as one minute or 21,600th part of earth's circumference at the equator, which knot diminishes towards either pole till it reaches 0—show why.

Usefulness of these lines.—Show that the position of a place cannot be settled by one line; but by the *crossing* of the lines any place can be fixed with the greatest accuracy. Give exercises at first in finding places whose latitude and longitude present little difficulty. Show the *convenience* of these lines in fixing the place of a shipwreck in mid-ocean, and hence a means of filling charts when latitudes and longitudes have been got—the *service* of these cross-lines to the navigator, who, with proper instruments, can determine at any time his position in degrees, etc., N. or S. of the equator, and how many degrees, etc., E. or W. of Greenwich. Instance the danger of *losing the reckoning*.

(2). *Coral Islands*, with few exceptions, are found only within the tropics, and oftenest in the Pacific Ocean, and appear to be formed on the tops of submarine eminences which are gradually sinking with the bed of the sea. This opinion, expressed by Darwin, is grounded on the fact that the creatures which make the coral can only work between the surface and 90 to 150 feet deep; and as the coral goes down much beyond that depth, it is inferred that the islands have been gradually sinking, which allows the animals to keep adding to the top, as they are still doing. The coral usually forms a ring from one to thirty miles in diameter, and about a quarter of a mile in width. These islands are called 'Atolls.' When coral comes near the surface it is called a reef, the one off Queensland being a natural breakwater 1000 miles long.

History.

	A.D.
1. The death of William I. was the result of an accident received on horseback	1087
William II. is supposed to have been assassinated in the New Forest	1100
Richard I. was killed designedly by a young man at the siege of Chaluz	1199
John is supposed to have been intentionally poisoned.	1216
Edward II. was assassinated in Berkeley Castle ...	1327
Richard II. is supposed to have been murdered in Pomfret Castle	1399
Henry VI. is supposed to have been murdered in the Tower	1471
Edward V. was murdered in the Tower ...	1483
Richard III. was designedly killed at Bosworth ...	1485
Charles I. was executed	1649
William III. was killed by accidentally falling from his horse at Kensington	1702

2. The conquest of Ireland was begun in the reign of Henry II.

The King of Leinster, Dermot, had been expelled from his territory for carrying off another chief's wife, and he applied to Henry for help. The English king had given permission to his adventurous barons to take up the quarrel, and some Norman knights of Wales had first crossed over to Wexford with a force of Norman horse and Welsh infantry in the summer of 1169.

In 1170 Richard, Earl of Pembroke, surnamed *Strongbow*, followed with a larger force, took Dublin, and by marriage with Dermot's daughter became, on Dermot's death, King of Leinster. In 1171 the king landed with a powerful body of knights, received homage from the Irish chieftains, and was received with due submission by Pembroke. Thus was Ireland nominally subdued.

Latterly the revolt of the American colonies, and the example of the French revolution, led to disturbances in Ireland, which culminated in rebellion, 1798. This showed the pressing need of measures to knit Ireland more closely to the interests of Britain. Pitt, in May, 1799, passed through the English Parliament a bill for the Legislative Union of Great Britain and Ireland. In June, 1800, the Irish Parliament was induced to pass it, and on the first day of the present century, January 1st, 1801, the Union began.

3. The most important events so far in the reign of Queen Victoria are:—

	A.D.
Penny Postage Established...	1840
Abolition of the Corn Laws	1846
Repeal of the Navigation Laws	1849
Great Exhibition of the Industries of all nations, and laying of sub-marine telegraph	1851
Russian War	1854-56
Indian Mutiny	1857
Jews admitted to Parliament	1858
New Reform Act	1867
Abyssinian War	1868
Disestablishment of Irish Church	1869
Irish Land Act	1870
Elementary Education Act	1870
Treaty of Washington (settlement of differences with America by arbitration) ...	1872
Irish Land Bill	1881

Composition.

COLONIZATION.

The formation of colonies is amongst the earliest occurrences recorded in history. Phœnicia, Greece, Rome, Venice, and Genoa were all famous for their colonies. The establishment of colonies in distant parts of the world by European nations during the sixteenth century was one of the most important events in the history of the world. Immediately that interest was excited in Europe by the discoveries of Columbus, the desire to acquire new territories seized on the minds of several European nations, and on the English amongst the rest. It would appear that the English are the only people of modern times who can colonize on a large scale successfully. Of European nations, besides the English, that formerly possessed a large colonial empire, the Dutch have retained more than any other.

Colonization has owed its increase to the difficulty of men to obtain employment, to low wages, and to the scarcity of food. Beyond the sea were lands of greatest richness lying unused by man, and by the bringing of the idle people and the waste lands

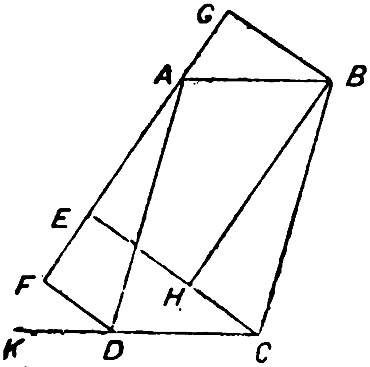
together, the greatest evil of the time was redressed. For a time colonization fell into discredit by the sending of criminals to the newly-acquired possessions, so that honest people refused to take up their abode with men who had committed serious crimes. In course of years the practice of sending convicts was stopped, and thenceforward immigration continued to increase immensely.

Owing to the thinness of population, compared with the size of many of our large colonies, labourers are scarce, and there is a great demand for immigrants. The kinds of people most in demand are farm servants of all kinds, artisans, and domestic servants. To meet the great demand for labour, Government has assisted and even given free passages to properly qualified persons. Free grants of land have been given to those who paid their own passage out.

The advantages conferred by the colonies on the mother country are great, and one of the most valuable is that they furnish a new home for thousands of poor who find it a difficult matter to gain a livelihood in their own country.

Euclid.

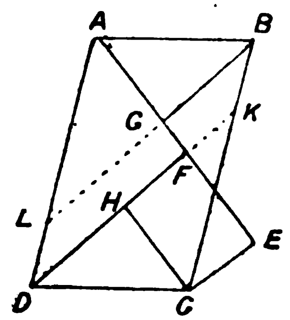
1. Let ABCD be a parallelogram. Through A draw FAG, and first let it pass without the figure, then the perpendiculars on it from B, and D, viz., BG, DF, shall be together equal to the perpendicular on it from C, viz., CE, these perpendiculars being the distances of the respective points from FG.



Through B draw BH parallel to GE; then the figure GBHE is a parallelogram, because BG is parallel to HE, being perpendicular to the same straight line. ∴ BG is = HE.

Again, because BC = AD, and the angle at F = angle at H, each being a right angle, and the angle ADF equal to the angle BCH, which may be shown by producing CD to K, for since the whole ADK = BCD, and the part FDK = to ECD, on account of the respective lines being parallel; then (by I. 26) the triangles AFD, BHC are equal in every respect and ∴ DF = CH. But HE was shown to be equal to BG. ∴ BG, DF are together equal to CE.

Secondly, let the line through A pass within the figure, as AGFE. Then CE shall be equal to the difference between BG and DF.



Through C draw CH parallel to EF, then HE is a parallelogram and ∴ HF = CE. Again, because DC = AB, and that the angles at G and H are right angles, and that if BG, DF be produced to L and K, the angles LDK, LBK are equal, being the opposite angles of a parallelogram, ∴ the remainder ABG = remainder CDH, since the whole angle ADC = whole angle ABC. Wherefore (by I. 26) DH = BG, and CE was shown to be equal to HF ∴ CE is equal to the difference between BG and DF.—Q.E.D.

2. Prop. 4, Bk. II.
3. Prop. 14, Bk. II.

Algebra.

1. (*a*) $(x-2y)^4 = (x^2-4xy+4y^2)^2 = x^4-8x^3y+24x^2y^2-32xy^3+16y^4$

(*b*) $-(2x-y)^4 = (4x^2-4xy+y^2)^2 = \underline{16x^4-32x^3y+24x^2y^2}$
$\underline{-8xy^3+y^4}$

Subtracting, there remains $-15x^4+24x^3y \qquad -24xy^3+15y^4$

Reversing the terms $15y^4-24xy^3-15x^4+24x^3y=$
$3(5y^4-8xy^3-5x^4+8x^3y=$

Adding and subtracting $5x^2y^2$
$3(5y^4-8xy^3+5x^2y^2-5x^2y^2+8x^3y-5x^4=$
$3(y^2(5y^2-8xy+5x^2)-x^2(5y^2-8xy+5x^2)$
$3(y^2-x^2)\,(5y^2-8xy+5x^2)=$
$\underline{3(y-x)\,(y+x)\,(5y^2-8xy+5x^2)}$ Q.E.D. Ans.

2 Let $6x$ = the No.
Then by the terms of the problem,
$3x\times 3x = 2x\times 2x\times 2x$
$9x^2 = 8x^3$
$9 = 8x$
$\frac{9}{8} = x$
∴ the No. $= \frac{9}{8}\times 6 = \underline{6\frac{3}{4}}$ or $\underline{\frac{27}{4}}$ Ans.

3. (1) $10x-11y = -12$ or $130x-143y = -156$
$13x-14y = -11{\cdot}7$ or $\underline{130x-140y = -117}$
$3y = 39$
$y = \underline{13}$

By substitution, $10x - 143 = -12$
$10x = 143 - 12$
$10x = 131$
$\underline{x = 13{\cdot}1}$ Ans.

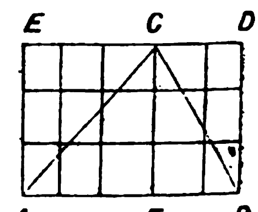
(2) $\frac{7x}{3} + \frac{3-x}{2x} = 20\frac{2}{3}$

Clearing of fractions, $14x^2 + 9 - 3x = 124x$
Transposing, $14x^2 - 127x = -9$
Dividing by 14, $x^2 - \frac{127x}{14} = -\frac{9}{14}$
Completing square, $x^2 - \frac{127}{14}x + \left(\frac{127}{28}\right)^2 = \frac{16129-504}{784} = \frac{15625}{784}$
Taking root, $x - \frac{127}{28} = \pm\frac{125}{28}$
$x = \frac{127}{28} \pm \frac{125}{28} = \underline{9}$ or $\underline{\frac{1}{14}}$

Mensuration.

1. The altitude of a triangle is the perpendicular let fall from the vertex upon the base or the base produced. Let ABC be a triangle, and ABDE a rectangle on the same base AB, and having the same altitude: the triangle is equal to half the rectangle.

Let CF be the perpendicular from C on AB. Then the triangle ACB is half of the rectangular parallelogram AEDB.



Now it may be easily shown (by dividing the sides and drawing parallel lines) that the product of the linear units in AE or FC, and similar linear units in ED, is equal to the number of square units in the whole rectangle, and since the area of the triangle is equal to half the area of the rectangle, then the rule may be written thus:—*The area of a triangle is half the product of the base and the altitude*, which is the same result as if the area of the rectangle was found and then halved.

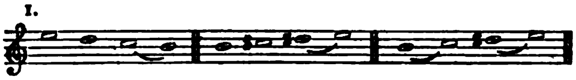
2. (*a*) 120ft. × 60ft. = 7,200 sq. ft. = 800 square yards.
A square chain = 22 yards × 22 yards = 484 square yards.
484 square yards cost 121s.
1 „ „ $\frac{121s.}{484}$
800 „ „ $\frac{121s. \times 800}{484}$
i.e., $\frac{800}{4}$s. $= \underline{£10}$

(*b*) 78ft. × 36ft $= \frac{78\times 36}{9}$ square yards = 312 sq. yds.
4d. × 312 = 104s. $= \underline{£5\ 4s.}$

Cost of levelling	=	£10
„ tennis court	=	5 4s.
∴ total cost	=	£15 4s.

Music.

1.



2.

3.

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Engagements for January.

January	4.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
„	6.	Finance of Orphanage, N.U.E.T.	7.30 p.m.
„	7.	Meeting of Executive, N.U.E.T.	11 a.m.
„	9.	Finance and General Purposes Committee, N.U.ET.	7.30 p.m.
„	11.	Geological Society	8 p.m.
		Anthropological Society	8 p.m.
„	12.	Royal Society	4.30 p.m.
„	13.	Finance Committee of Benev. Fund, N.U.E.T.	7 p.m.
		New Shakspere Society	8 p.m.
„	16.	Central Committee of Benev. Fund, N.U.E.T.	7.15 p.m.
„	18.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
„	19.	Royal Society	4.30 p.m.
		Linnean Society	8 p.m.
„	20.	Meeting of Executive, N.U.E.T.	7 p.m.
„	21.	Organisation Committee, N.U.E.T.	10 a.m.
		General Board, N.U.E.T.	11 a.m.
„	23.	Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
„	25.	Geological Society	8 p.m.
		Anthropological Society Anniversary	8 p.m.
„	26.	Royal Society	4.30 p.m.
„	27.	Browning Society. James Thomson on 'Browning's Genius.'	8 p.m.

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'How I Teach Arithmetic.'

(*Continued from page 432.*)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

We shall next, in somewhat natural sequence, as we have step by step been working up to it, consider the teaching of that important branch of Arithmetic comprehended under the generic term *Percentages*—the commercial or higher-business man's practical Arithmetic. The word has, in the singular number, for some years obtained such a terrible ascendancy in the scholastic vocabulary that it has almost come to have the same effect on the profession that a red flag has on the lord of the bovine creation. Here, however, we trust it will be found perfectly innocuous.

In commencing the teaching of Percentages, I first try to instil into the minds of the scholars a clear idea of the meaning of the term *per cent.*—so much or so many per 100. When money is referred to, it means on each 100 *pounds*, and when any other concrete number is considered, it means so many out of each 100 of that number. For instance, when we speak of money making 5 per cent. interest, or of goods being sold at a profit of 15 per cent., we simply mean in the former case that £100 makes £5 interest, or that some principal greater or less than £100 makes at the *rate* or proportion of £5 for £100; and in the latter case that goods bought for £100 were sold at a profit of £15, thus selling for £115; or at the *rate* of £15 profit on £100, whatever the money originally spent on the goods might be. When concrete numbers other than money are referred to, as 20 per cent. of a number of boys, it denotes 20 boys out of 100 boys, or that proportion of the boys, whatever the number on which the percentage to be taken might be.

I now give a number of easy examples to be worked mentally:—Find the interest of £200 at 5 per cent.; £250 at 4 per cent.; £650 at 3 per cent.; £825 at 6 per cent. In the last example explain—each of the others being, however, explained if required—that £825 = 8¼ hundreds, consequently the interest will be 8¼ times £6 = £49 10s. Give a score or two of such questions till even the slower ones are able to answer, having heard question after question worked out.

Now work out mentally some other concrete exercises—not money. In a school of 200 children, 5 per cent.—that is, per 100—are late; how many are late? Out of 300 four per cent. were late? Out of 250 two per cent. were late? Here, as 250 = 2½ hundreds, there must have been 2½ times 2 = 5 scholars late. I now present a different phase of these exercises:—If 10 boys are late out of 200, what is the rate per cent.? If 12 are late out of 300? If 15 are late out of 250? Here 250 = 2½ hundreds, and as we want to know how many were late out of every 100, then 15 ÷ 2½, or 30 ÷ 5 = 6 per cent. Ans.

Having given some general notion of the application of the term *per cent.*, we will now consider *seriatim* and in detail the various specific operations included in the general term Percentages.

(*a*) The sub-division generally taken first is *Simple Interest*, with which we at once proceed. I first define interest—money paid for the loan of a sum of money, called the principal; and rate per cent. as previously defined, remarking that this rate is so much for *one* year, unless otherwise specially mentioned. We now at once commence working exercises freely on the board, the first being in finding (*a*1) the *simple interest of a sum of money for a given time*, and first for a year. Find the interest of £420 at 5 per cent. We will work this exercise by different methods, in order that the *rationale* may be thoroughly understood, so that in the future working of such questions the method that commends itself as the easiest in any particular case can be easily resorted to. (1) I explain that 5 per cent. $= \frac{5}{100} = \frac{1}{20}$, hence that the interest is $\frac{1}{20}$ of the principal, so that £420 ÷ 20 = £21. Ans. In practice I adopt this plan more frequently than any other. (2) As £420 = 4⅕ hundreds, £5 × 4⅕ = £21. Ans. This method is convenient when the principal can be easily expressed in hundreds and the decimal or fraction of a hundred. (3) As 5 per cent. is $\frac{1}{20}$, the interest is just a shilling for every £ in the principal, hence the interest must be 420 shillings = £21. Ans. This method is handy when the rate is also 2½ per cent., that is, sixpence in the £, or $\frac{1}{40}$; also when it is 3¾ per cent., that is, ninepence in the £. The application of this method is limited, being only available when the rate is a multiple or sub-multiple of those just given—thus 7½ per cent. = 1s. 6d. in the £, 1¼ per cent. = 3d. in the £, or $\frac{1}{80}$, etc. (4) *One* per cent. of £420 = £4·2, hence £4·2 × 5 = £21. Ans. This method is useful when there are £'s only—no shillings and pence—or when these will easily come out in the terminate decimal of a £. (5) Multiply by the rate per cent. and divide by 100, then (£420 × 5)

$\div 100 =$ £21. Ans. This is the most common, but the least rational, method adopted, being in principle the same as method 4, the multiplying being done before the dividing; but the 'rule' is too generally resorted to without an intelligent appreciation of its reason.

We will now work out a few examples, and make them the basis of any remarks that may be required. Find the interest of £625 12s. 6d. at $4\frac{1}{2}$ per cent.

(1)

	£	s.	d.
4 p. c. is $\frac{1}{25}$	625	12	6
$\frac{1}{2}$ „ „ $\frac{1}{8}$	25	0	6
	3	2	$6\frac{3}{4}$
Ans.	£28	3	$0\frac{3}{4}$

(2)

	£
4 p. c. is $\frac{1}{25}$	625·625
$\frac{1}{2}$ „ „ $\frac{1}{8}$	25·025
	3·128125
	£28·153125
	20
	s. 3·0625$\cancel{0}\cancel{0}$
	12
	d. 0·75$\cancel{0}\cancel{0}$

(3)

£	s.	d.
625	12	6
		$4\frac{1}{2}$
2502	10	0
312	16	3
£28·15	6	3
20		
s. 3·06		
12		
d. 0·75		

(4)

6·25625
4·5

3128125
2502500

£28·153125. Ans.

The scholars who work percentages being fairly up in fractions and decimals, each of the above methods is easily intelligible to them. In No. 1 we have taken 4 per cent., which is $\frac{1}{25}$ of 100, and then $\frac{1}{2}$, which is $\frac{1}{8}$ of the 4. A boy at this stage ought to be so well up in mechanical working that he can easily divide by 25 by short division. In No. 2 we have brought the 12s. 6d. to the decimal of a £, which most boys can easily do mentally,—being $\frac{5}{8} = \cdot625$. We then proceed as in No. 1. In No. 4 we have mentally divided the £625·625 by 100 = £6·25625, which is the interest at *one* per cent., and then multiplied by the rate required—$4\frac{1}{2}$. In No. 3 we have adopted method 5 as referred to above. In giving a class an early lesson, I exhibit all these methods simultaneously on the board, and remark well on each of them, leaving the scholars to adopt which measure they prefer in their own working.

Another example,—What is the simple interest of £476 13s. 9d. for $4\frac{1}{2}$ years at 6 per cent. per annum?

(1)

	£	s.	d.
5 p. c. is $\frac{1}{20}$	476	13	9
1 „ „ $\frac{1}{5}$	23	16	$8\frac{1}{4}$
	4	15	$4\frac{1}{20}$
int. for 1 yr.	£28	12	$0\frac{3}{10}$
			$4\frac{1}{2}$
	114	8	$1\frac{1}{5}$
	14	6	$0\frac{3}{20}$
Ans.	£128	14	$1\frac{7}{20}$

(2)

£4·766875 int. at 1 p. c. for one year.
6

28·601250 „ 6 „ „ „
4·5

143006250
114405000

£128·7056250 „ „ „ $4\frac{1}{2}$ years
20

s. 14·1125$\cancel{0}\cancel{0}$
12

d. 1·35$\cancel{0}\cancel{0}$

(3) £476 13s. 9d. $\times 6 \times 4\frac{1}{2} =$ £12870 11s. 3d., which divided by 100 = £128 14s. $1\frac{7}{20}$d. Ans.

Method 1 above is self-evident. In method 2 we have £476 13s. 9d. = £476·6875 = £4·766875 *hundreds* of £'s, the remainder being easy to follow. In this case method 3 is the shortest, though the least rational. I here explain that instead of dividing the principal by 100 at first, and then multiplying by 6 and $4\frac{1}{2}$, we simply multiply first, and then divide afterwards.

I should now explain the term *amount*—the sum obtained when the interest has been added to the principal—and work a question requiring it. What is the amount of £756 15s. for 3 years 10 months at $3\frac{1}{3}$ per cent. per annum? Here, first elicit that $3\frac{1}{3}$ is $\frac{1}{30}$ of 100, hence that a year's interest is $\frac{1}{30}$ of the principal—£756 15s. $\div 30 =$ £25 4s. 6d., a year's interest. Then, 3 years 10 months = $3\frac{5}{6}$ years, hence £25 4s. 6d. $\times 3\frac{5}{6} =$ £96 13s. 11d. the total interest, which added to the principal £756 15s. = £853 8s. 11d., the amount. Ans.

(*a2*) We will now *find the rate per cent.* when the interest of some specified principal for a given time is known.

Example:—At what rate per cent. will £450 amount to £508 10s. in $3\frac{1}{4}$ years? Here reiterate what rate per cent. really means—the interest of *one* hundred £ for *one* year; and we have in the question the interest of a *number* of hundred £'s ($4\frac{1}{2}$) for a *number* of years ($3\frac{1}{4}$).

£508 10s. − £450 = £58 10s., int. of £450 for $3\frac{1}{4}$ yrs.

£58 10s. $\div 4\frac{1}{2}$ (hundreds) = £13, int. of £100 for $3\frac{1}{4}$ yrs.

£13 $\div 3\frac{1}{4}$ (years) = £4, int. of £100 for 1 yr. Ans.

Another example:—At what rate would £162 10s. amount to £184 8s. 9d. in $4\frac{1}{2}$ years, simple interest? We will work this question decimally. £162 10s. = £162·5 = 1·625 hundreds, and £184 8s. 9d. = £184·4375, then

£184·4375 − £162·5 = £21·9375, int. of 1·625 hrds. for $4\frac{1}{2}$ yrs.

£21·9375 $\div$ 1·625 = £13·5, int. of 1 hrd. for $4\frac{1}{2}$ yrs.

(£13·5 $\div 4\frac{1}{2}$) = (£27 $\div$ 9) = £3. Ans. Int. of 1 hrd. for 1 year

We will also work this question by compound proportion—

£184 8s. 9d. – £162 10s. = £21 18s. 9d. = £$21\frac{15}{16}$ = £$\frac{351}{16}$, the interest on £162 10s. for $4\frac{1}{2}$ years. £162 10s. = $1\frac{5}{8}$ hundreds = $\frac{13}{8}$ hundreds. $4\frac{1}{2}$ years = $\frac{9}{2}$ years. Then stating and cancelling, we have—

$$27\ \frac{\cancel{351}\times\cancel{8}\times\cancel{2}}{\cancel{16}\times\cancel{13}\times9}=\frac{27}{9}=£3.\ \text{Ans.}$$

In cancelling, the 8×2 eliminates the 16, and the 13 goes into the 351. Proportion is often the shortest method of doing this kind of question, as it is in this case.

(a3) We will next *find the time* in which a sum of money will make a given amount of interest in a specified time. Example:—In what time would £1,625 amount to £1,824 6s. 8d. at $3\frac{1}{5}$ per cent. per annum? Here we simply work on first principles, finding the interest produced in *one* year, and then seeing how often this one year's interest is contained in the given interest. £1,824 6s. 8d. – £1,625 = £199 6s. 8d. the given interest. £1,625 = $16\frac{1}{4}$ hundreds, and (£$3\frac{1}{5}\times16\frac{1}{4}$) = ($\frac{16}{5}\times\frac{65}{4}$) = £52, the interest for *one* year; then £199 6s. 8d. ÷ £52 = $3\frac{5}{6}$, the number of years = 3 years 10 months. Ans. In dividing, the £199 6s. 8d. = £$199\frac{1}{3}$ by £52, bring both to thirds of £'s = 598 ÷ 156 = $3\frac{130}{156}$ = $3\frac{5}{6}$ years. Ans. In teaching a class I should here remark that although one sum of money cannot be *multiplied* by another, both being concrete numbers, we may by dividing see how often one sum of money is contained in another, just on the same principle as we find (say) how many times 9 apples is contained in 72 apples. A caution here is needed that the quotient obtained is not money (£ s. d.), but an abstract number, representing, however, it may be, something concrete, as $3\frac{5}{6}$ *years* above.

Before commencing to divide, the two amounts should be brought to the same denomination.

Another example:—In how many years would £600 amount to £750 at $3\frac{3}{4}$ per cent. per annum? We will work this question by compound proportion, first reading it in a more explicit form, thus:—If £100 makes £$3\frac{3}{4}$ (= £$\frac{15}{4}$) interest in one year, in how many years will £600 make (£750 – £600 =) £150 interest at the same rate? First bringing the two amounts of interest, £$3\frac{3}{4}$ and £150, to *fourths* of £'s, to get rid of the fraction ($\frac{3}{4}$), we have 15 and 600; then stating, we have:—

year. pr. interest.

$$\frac{1\times1\times40\cancel{600}}{6\times\cancel{15}}=\frac{40}{6}=6\frac{2}{3}\text{ years. Ans.}$$

In the above statement we have represented the two principals in *hundreds* of £'s, their simplest ratio, instead of £$\frac{100}{600}$.

(a4) We now proceed to *find the principal* which will amount to a certain sum, or, in other words, produce a specified interest in a given time at a given rate per cent. Example:—What principal at simple interest would amount to £487 18s. at 4 per cent. for $4\frac{3}{4}$ years? Here we might find what *any* principal would amount to at 4 per cent. for $4\frac{3}{4}$ years, and then whatever fraction or proportion this supposed principal is of its amount, so the principal required will be of the given amount—£487 18s. The most convenient supposed principal is £100, then £$4\times4\frac{3}{4}$ = £19, interest of £100 for the given time; hence £100 would *amount* to £119, consequently the principal is $\frac{100}{119}$ of the amount, and $\frac{100}{119}$ of £487 18s. = £410. Ans. The simplest method of obtaining $\frac{100}{119}$ of £487 18s. is by representing it as £487·9, then mentally multiplying it by 100 = £48,790, which divided by 119 = £410.

Another example:—What principal will amount to £369 0s. $2\frac{1}{2}$d. in $4\frac{1}{6}$ years at $3\frac{1}{4}$ per cent. per annum? Here £$3\frac{1}{4}\times4\frac{1}{6}=\frac{13}{4}\times\frac{25}{6}=\frac{325}{24}$ = £$13\frac{13}{24}$, interest of £100 for the $4\frac{1}{6}$ years, hence £100 would amount to £$113\frac{13}{24}$ in the given time; the principal is therefore

$$\frac{100}{113\frac{13}{24}}=\frac{2400}{2725}=\frac{480}{545}=\frac{96}{109}\text{ of the amount, then}$$

(£369 0s. $2\frac{1}{2}$d. × 96) ÷ 109 = £325. Ans.

As every question in simple interest must come under one or other of the above four headings, before proceeding further I devote a week or two to working out a number of dissimilar questions, so as to bring into requisition the knowledge acquired. Here the first 80 questions from 'Percentages' in my own series come in opportunely, and are supplemented by a number of questions from Colenso's, Mansford's, or any other manual of arithmetic, and by setting *ad libitum* original questions on the board. In working original questions I very rarely have any difficulty in ascertaining the true answer, as when three or four of the best workers have honestly the same answer, they are nearly certain to be right. Should there be the least doubt, I work out the question on the board in presence of the whole class. I would here remark that in finding the interest of a sum of money from one date to another, the worker is often in doubt whether he should reckon *both* the given days, or only *one* of them, or *neither* of them. Of course the true interest, as a banker would reckon it, and as common sense would suggest, would be obtained by reckoning one of the days only, if no directions were given; as a sum of money invested one day and taken out the next would only be one day at interest, or if invested one (say) Monday and taken out the next Monday would only bear 7 days' interest, not 8 days. For instance, from April 14th to July 26th, I should reckon 16 days for April, omitting the 14th, but reckoning July 26th, making in all 103 days; hence the interest for these days would be $\frac{103}{365}$ of a year's interest. In every question in arithmetic, the data should be explicit, nothing doubtful or ambiguous about them; yet nearly in every batch of questions issued by the Education Department, whether to pupil teachers, Queen's scholars, or students, I can find one or more questions puzzlingly lacking in definiteness. If the full working of a question is carefully looked over by the examiner, which takes considerable time, so that the view the worker had of what was required is appreciated, and the work be valued accordingly, not much harm will be done; but if only a specific result (answer) must be obtained, then the worker may be seriously wronged. I remember many years ago a pupil teacher being shown his worked paper by an Inspector, who told him gravely that one of the questions was seriously wrong—and seriously wrong it certainly was in the answer—and casting my eye cursorily over his paper I saw and pointed out that this 'serious wrong' was, that in a question in interest, in which the answer was to be the *amount*, he had only given the *interest*—his omission to add the interest to the principal.

(To be continued.)

Recent Inspection Questions.

[The Editor respectfully solicits contributions—all of which will be regarded as STRICTLY PRIVATE*—to this column. For obvious reasons, it cannot be stated in which district the questions have been set.]*

Arithmetic.

STANDARD I.

(1) Add together,—three hundred and eighty-nine, fifty-seven, eight hundred and sixty, seven hundred and twenty-six, and five hundred and sixty-four. Ans. 2596.

(2) From six hundred and forty-three, take four hundred and seventy-nine. Ans. 164.

(3) Find the difference between seven hundred and five, and two hundred and sixty-nine. Ans. 436.

STANDARD II.

(1) Multiply sixty-eight thousand four hundred and seventy-five, by seventy-eight. Ans. 5,341,050.

(2) Divide sixty-nine thousand nine hundred and thirty-one, by nine. Ans. 7770,—1.

(3) From sixty-four thousand two hundred and fifty, take thirty-nine thousand eight hundred and twelve. Ans. 24,438.

STANDARD III.

(1) Divide four millions and seventy-six thousand three hundred and sixty-one, by six hundred and seventy-three. Ans. 6057.

(2) Add together,—eight hundred and forty three pounds thirteen shillings and eightpence three farthings, one hundred and sixteen pounds six shillings and elevenpence, eight thousand and ninety-four pounds eight shillings and fourpence halfpenny, three hundred and nineteen pounds three shillings and threepence three farthings, and six thousand and twenty-eight pounds eighteen shillings and sixpence halfpenny. Ans. £15,402 10s. 10½d.

(3) Find the difference between twenty-three thousand eight hundred and forty-three pounds thirteen shillings and sixpence halfpenny, and nine thousand nine hundred and eighty-nine pounds seventeen shillings and sixpence three farthings.

Ans. £13,853 15s. 11¾d.

(4) I pay £13 17s. 11½d. to one person, and £29 2s. 6d. to another. I then receive £8, and find £9 5s. 0d. in my purse when I get home. How much had I at first? Ans. £44 5s. 5½d.

STANDARD IV.

(1) Multiply seven hundred and fifty-five pounds twelve shillings and ninepence farthing, by ninety-two. Ans. £69,518 14s. 11d.

(2) Divide five hundred and twenty-eight thousand and seventy-six pounds ten shillings and a penny three farthings, by five hundred and twenty-seven. Ans. £1002 0s. 10¼d.

(3) Bring eleven million and twenty-two ounces to tons. Prove the answer. Ans. 306 tons 18 cwt. 1 qr. 17 lbs. 6 oz.

(4) How many persons can receive 15s. 1d. each out of £40 14s. 6d? Ans. 54 persons.

STANDARD V.

(1) 3191 @ £1 9s. 5¾d. Ans. £4703 8s. 0¼d.

(2) 79 cwts. 3 qrs. 16 lbs. @ £2 12s. 6d. a cwt. Ans. £209 14s. 4½d.

(3) 23 yards @ 5s. 6d. per yard.
33 " 0s. 11¾d. "
2 dozen gloves @ 1s. 10d. per pair.
10 yards @ 1s. 10d. per yard.

Ans. £9 19s. 1¾d.

(4) If 98 sheep cost £352, what would 2 cost? Ans. £7 3s. $8\frac{4}{49}$d.

STANDARD VI.

(1) Divide the sum of $\frac{1}{12}$ and $(\frac{1}{4} - \frac{1}{8})$ by the sum of $\frac{1}{3}, \frac{1}{6}, \frac{1}{9}$; and find the value of $(3\frac{1}{2} \times 2\frac{1}{3}) \div (\frac{4}{15} \times \frac{9}{8})$ of £3. Ans. $\frac{15}{44}$; £81 13s. 4d.

(2) If 20 men do a piece of work in 12 days, working 9 hours a day, how many men will do twice as much work in 8 days, working 6 hours a day? Ans. 90 men.

(3) A man owns ·375 of a ship. He sells ⅔ of his share for £1260. What will be the value of the whole ship? Ans. £5040.

(4) 37·004 × ·00473. Divide the product by ·1892. Ans. ·9251.

Dictation.

STANDARD I.

The wool of the sheep is white.

STANDARD II.

There he is safe from the dogs but not from the guns of the hunters. But they dare not go too near, lest he should spring upon them. They keep at some distance and try to shoot him.

STANDARD III.

If another soldier comes up he will seize his comrade, and so help him to pull away the others. They are so bitter against their enemies, that they will sooner suffer themselves to be torn in pieces than let go their hold. Some kinds will attack others that are twice as big as themselves, trusting to their superior numbers and going two against one.

STANDARDS IV., V., and VI.

The forest is now almost dark, the foliage overhead having become so dense that the moon penetrates through it only in a few places, rendering the surrounding mosses darker by contrast. The outline of an old shoe-track, at first faintly seen, is soon no longer visible; but still the Indian moves forward with rapid, noiseless steps, as sure of his way as if a broad beaten track lay before him.

Grammar.

STANDARD IV.

Parse these sentences :—

1. What shall I say?
2. Whose flowers will he bring?
3. Whom will they seek next?

STANDARD V.

1. Parse :—
 (*a*) The women had just left their room.
 (*b*) I have been there.
 (*c*) Jane will be lost.
2. Analyse :—
 There is no doubt at all about the truth of George's sayings.

STANDARD VI.

1. Parse :—
 (*a*) All is not gold that glitters.
 (*b*) Playing with edged tools is dangerous.
 (*c*) Let all remain but you.
2. Analyse :—
 If you tell me that it is wrong to do so, I will of course attend to you.

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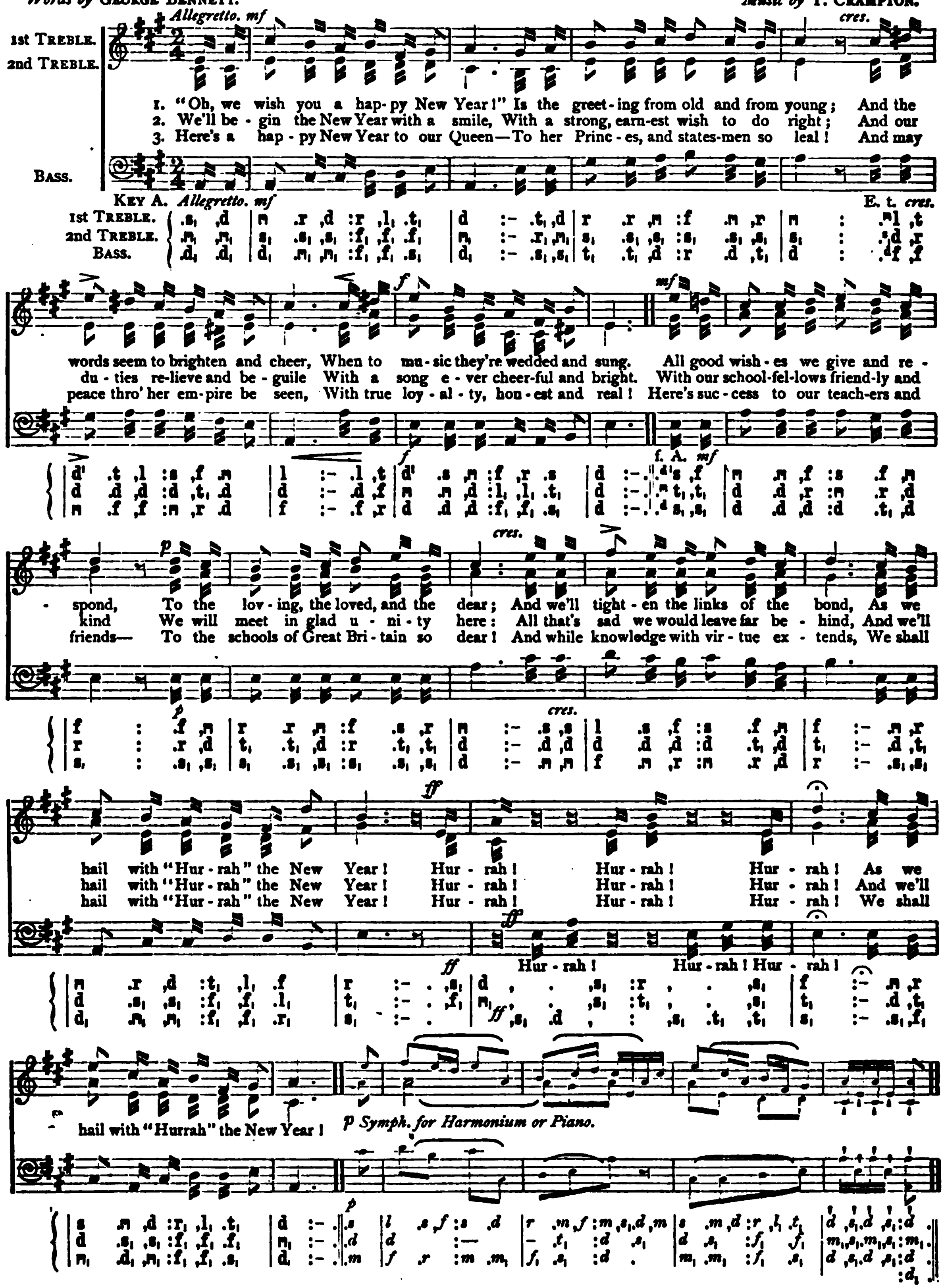
Words by GEORGE BENNETT. *Music by* T. CRAMPTON.



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The Editor cannot return rejected MSS.; authors should therefore retain copies.

*** *We regret that, owing to the great pressure upon our space, the 'Monthly Notes' and 'Gossip' are again crowded out.*

The Hon. Lyulph Stanley, M.P., and the Westminster Training College.

BY THE EDITOR.

ALL well-informed friends of denominational education who peruse the proceedings of the London School Board must have been more annoyed than alarmed at some remarks made by a prominent member on the 10th ult. The business which occupied the Board's attention was a 'Memorial to the Lords of the Committee of Council on Education' on what the now defunct 'Teacher' was pleased to style 'The Training College shibboleth.' In the course of the debate, which was opened by the Rev. Thomas Morse, the Hon Lyulph Stanley, M.P., is reported by one of our contemporaries to have said:—

> 'He must say, from what he had heard from teachers who had gone through colleges, of the discipline, the treatment, and the attitude of the principals towards the young people, that the relation in which they seemed to stand to the principals was that of third or fourth standard children in elementary schools. He knew of one college in which there was a want of generosity and a want of trust in the honour of the students, which he thought would be discreditable to any school, even one in the poorest part of the metropolis.'

At this point, a Churchman—jealous, we presume, of the honour of the institutions whose interests he represented—promptly pulled him up by demanding the name of the College.

> 'The Hon. Lyulph Stanley said it was not a Church college. It was the Westminster Training College, and he had the information before him.'

As an old student of this College, we cannot let these scurrilous remarks pass unchallenged. After making allegations so grave as these, in common justice to his informer, himself, and, above all, to Westminster, 'the information before him' should no have been withheld. It seems to us a pity this bald statement, unsupported by one tittle of evidence, should have gained currency.

We highly respect Mr. Stanley for his past services to the profession; the manful way in which he stood by Mr. Goffin should win for him the abiding gratitude and esteem of every teacher in the country. The part he played in that unpleasant business was a noble one; it is not lightly valued, nor will it soon be forgotten.

But in this case we cannot but think he has been duped by some chagrined individual seeking to do harm to a most worthy institution. The charges which he prefers against Westminster are as groundless as they are serious. We ought to know something of the 'want of generosity' and 'want of trust in the honour of the students,' if these things exist, considering that our acquaintance with the Westminster College now extends over a period of fourteen years. Two of these years were passed within its walls as a student, and we deem it a privilege, as it is a pleasure, to emphatically deny that there exist the slightest

grounds for the complaints made by Mr. Stanley. And we feel sure, that in so speaking, we answer (almost to a man) for the hundreds of our personal friends who were trained at Westminster. It is not saying too much when we affirm that there is no set of men who entertain a sincerer regard for their *Alma Mater*, and who are more loyal to the permanent staff, than old Westminsters.

That occasionally a black sheep has disgraced himself, and has had dealt out to him a well-merited chastisement, we do not deny, but in what college or profession has this not been the case?

We believe that even the profession which the Hon. Member for Oldham adorns is not exempt from these black sheep.

Mr. Stanley has evidently taken for granted the truth of his information without making due enquiry. He surely is ignorant, and grossly so, of the character of the men at whose door these charges are practically laid. Had he had even a passing acquaintance with the Vice-Principal—not to speak of Dr. Rigg, his respected and vigorous chief—he would have known how impossible it was for the state of things which he describes to exist. Whatever other colleges may be—and we have not a single word to set down against any of them—Westminster yields to none in her honourable, generous, kindly—nay, affectionate treatment of her students; and all who are able to speak with the authority of knowledge will bear us out when we say that this truly honourable dealing is heartily reciprocated by the students, both present and past.

But supposing, for the sake of argument, that we allow that the lamentable picture with which Mr. Stanley presents us is, and has been for years, a true one, how comes it that Westminster men have the very best schools in the country—schools in which it is the practice to spend at least one hour a day in religious teaching? We make this statement not on our own authority, but on that of Mr. Mundella himself. The Vice-President, in replying to the Wesleyan deputation which waited upon him on November 23rd, said, 'Yours are the best schools of the country, and take the largest grant.'

This result seems strangely at variance with the discipline of the College where the masters of these schools were trained—a discipline that 'would be discreditable to any school, even one in the poorest part of the Metropolis.'

We cannot now enter fully into the question which engaged the attention of the Board at the meeting to which we referred in our opening sentence. Roughly speaking, however, it seems to us that the qualifications of a candidate seeking admission into one of our training colleges should be threefold: physical, intellectual, and moral. Of the first the medical officer quickly disposes; the scholarship list determines the second; and we sincerely hope the day is far distant when the authorities of the different colleges will not be allowed to make searching and thoroughly satisfactory enquiry with regard to the third.

We rejoice to know that the heads of our normal institutions are not ashamed to own that it is their earnest endeavour, not only to turn out skilful teachers, but Christian men and women, who shall set an example in their lives worthy of all emulation.

We trust Mr. Stanley's proofs will speedily be forthcoming, or that he will for once own that in his eager desire to help the weak, and to secure fair-play for all, he has lent his ear to the malicious wailings of an individual unworthy of his aid.

Publications Reviewed.

*** We are sorry to disappoint the many friends who desire us to quote the price of each work noticed in our columns. This we would respectfully point out is the publishers' duty and not ours; we give publicity enough to a book when we review it. Our readers should peruse the advertisements in our pages, and failing to find the price here, it would be no great trouble or expense to drop a line to the publishers whose name and address we will gladly give.

Lectures on Teaching. By J. G. Fitch, M.A. Cr. 8vo, 436 pp. London: Cambridge Warehouse, 17, Paternoster Row.

THIRD NOTICE.

In the next lecture Mr. Fitch dwells on the importance of the study of language. He shows that our 'Grammar Schools' have failed to secure for the vast majority of their pupils anything like a 'classical education.' But, whilst desirous that Greek and especially Latin should be retained in some schools, the lecturer evidently inclines to the opinion that as instruments of mental discipline French or German may serve nearly as well as a dead language, and even that 'you can make the teaching of physical science as fruitful, as thoroughly disciplinal, for all the higher purposes contemplated in a liberal education as the teaching of Greek or Geometry' (p. 397.) We agree with Mr. Fitch that the mental discipline which should be the main result of a liberal education, is due less to the instrument than to the mode in which that instrument is used. Methods of instruction are, in this respect, of more importance than the subjects of study. *How* a pupil is taught vastly outweighs the *what*. But the 'state of things' in our Grammar Schools 'is being slowly mended,' and there is reason to hope that as they are 'modernized and improved' other subjects will 'assert their right to recognition,' and the 'hurtful predominance' of the almost exclusive study of Latin and Greek will cease. But when Latin *is* taught, Mr. Fitch insists on the constant comparison of its idioms and structure with those of the English language. If French or German be adopted, the conversational method is to be preferred in the earliest stages, but always with the same practice of comparison or contrast. Many practical hints are given as to methods, and, in conclusion, as to selection of masters for teaching the modern languages. These hints are all of great value to many of our readers who are engaged in teaching languages. 'Arithmetic,' says our author, 'deserves a high place in our educational system, mainly on the ground that it is to be treated as a logical exercise, and relatively to the needs of a beginner is, as a science, just as valuable as the higher mathematics to a university student.' In the tenth lecture arithmetic is treated as an art, 'an instrument for the solution of problems'; and in the eleventh its scientific use 'as a

means of calling out the reasoning faculty' is separately discussed. Most valuable hints are given in both chapters, the mere enumeration of which would occupy too much space. The author insists upon the general principle 'that the nature of each process should be made familiar by oral exercise before recourse is had to pen or pencil at all,' and he gives by way of contrast an example of 'working by rule'—a process which 'will do more to deaden than to invigorate the thinking faculty of any one who practises it.'

We quote an opinion which is of practical value, that 'it must not be set down as a fault if a child at first counts with his fingers.' Some examiners entirely forbid this practice. We agree with Mr. Fitch. Beginners cannot deal with abstractions. This whole subject of arithmetic seems to enlist the author's special sympathies, and we think he is right in urging increased attention to it, especially where, as in many girls' schools, this 'training in logic' has been sadly neglected.

'Geography and Fact-lore' is the subject of the twelfth lecture. Thoughtful teachers feel that physical geography is the basis of all true geographical instruction; and were examination-papers framed accordingly, the injunction to 'connect from the first physical geography with that which is called political,' would be more generally obeyed. The subject is so wide in its range of facts, that the study of topography resolves itself into one of selection, for we cannot say with reference to any centre that the facts 'diminish in importance as the square of the distance.' 'We should begin with what is known and what is near,' and the ideas thence derived should be gradually extended. In the development of this plan it is shown that 'Geography' may 'be a really educational instrument.' But Mr. Fitch has 'observed that this is the favourite subject often with the worst and most mechanical teachers,' who can present a 'maximum of result with a minimum of intellectual effort.' Nevertheless, the most skilful teachers may find scope for the exercise of their highest powers in connection with geographical lessons, the purpose of which should be 'to increase the pupils' interest in the world in which they live, to awaken their observant faculties, and to help them to recognise the order, the wealth, and beauty of the visible universe.' Suggestions are offered under this head which must be very useful.

The chapter concludes with some remarks on 'Fact-lore,' instruction in which (by means of object-lessons, etc.,) should be given on a definite plan and subserve a scientific purpose. The value of such lessons can hardly be overrated, for, in addition to the 'fact-lore' acquired, the correct use of words and an increased available vocabulary must result. We are glad to find that the Proposals for the Code, 1882, indicate a desire to foster this kind of knowledge in the elementary schools of the country.

For the teaching of History, Mr. Fitch in his thirteenth lecture especially urges that the text-book 'be treated as supplementary and wholly subordinate to oral lessons,' or, if used in the class at all, that it should 'be read aloud, explained, amplified, commented on, and made vividly interesting'—an alternative which, except as to order of thought, amounts to nearly the same thing. Picturesque verbal descriptions demand on the teacher's part a great knowledge of detail, but to the learner such lessons are invaluable. When the 'events' and their relations are 'seen' 'chronology' is necessary, and certain modes of assisting the memory of dates are discussed with advantage. The usefulness of biographical studies and of historical readings in 'kindling a strong interest in the subject' is pointed out by Mr. Fitch, who in conclusion urges the addition of special lessons on the English Constitution and the duties of citizenship, and the cultivation of the spirit of patriotism.

Natural Science is the last subject of instruction treated of in this series. The lecturer asserts for it a proper claim, not only on account of its 'practical usefulness,' but also because of 'the extreme beauty of the truths themselves.' To its disciplinal power we have already referred as compared with that of the study of 'the classics.' The processes of mind required are precisely those which are needed in all the intercourse of life—temper, reserve, breadth of mind, wide observation of details in order to generalization, for it is by the inductive process that men form the principles on which they reason and act. After naming the obviously practical value of Natural Science to our artizans and to the nation in changing mere 'hands' into intelligent workers, Mr. Fitch gives good advice on Trade Schools, and insists on the paramount importance of so teaching children that they shall 'be made observant and intelligent.' Every one will accept this result as far preferable to a mere acquaintance with the terminology of one or even of several branches of Natural Science.

The concluding lecture briefly reviews the whole course under the title of 'The Correlation of Studies.' The reader is reminded that a 'good teacher seeks to give to each class of faculty a fair chance of development'; and, in opposition to the maxim, *Non multa, sed multum*, is asked to believe that—

> 'A pupil who leaves school, knowing only one language besides his own, and having learned it by comparison with his own, knowing also one branch of mathematics besides arithmetic, and one branch of Natural Science, is better educated—better fitted to receive all the subsequent knowledge which the experience of life may bring, and to know what to do with it, than the classical scholar, the mathematician, or the scientist pure and simple.'

Mr. Fitch, however, does not contend for 'many subjects' of study, but, on the contrary, advises the succession of branches of a cognate character, in order that unity of purpose may be maintained as well as a regulated harmony in all its parts, prolonged attention being given to a particular study occasionally. At school there is rarely an opportunity, and no attempt should be made, to develope special aptitudes. Industrial schools may be adapted to such experiments: but ordinarily special tastes should be consulted *after* leaving school.

But we must go no further. Zealous young teachers who look to the future will avail themselves of such help as these lectures afford in perfecting their knowledge of principles and methods of school management. With increased experience they will be the more ready to agree with the author that—

> 'A school is a very unsatisfactory institution, and fails to fulfil its highest function, if, however it may succeed in imparting knowledge, it does not also succeed in imparting a thirst for more, or at least a dawning sense of the inward need for mental and spiritual cultivation, whether such cultivation bears any visible relation to success in life or not.'

And with a sense of his responsibility, but under a consciousness of a vocation to his work, the teacher

> 'Will ever possess within him one of the strongest of all motives to action; for while he is doing his work, he will habitually recognise, and will teach his scholars to recognise, the unseen presence in their midst of One who is the Helper of all sincere learners, and the Teacher of all true teachers.'

School Management and Method in Theory and Practice. By John J. Prince. 2nd Edition. John Heywood.

An interesting and hopeful feature of Education in England at present, is found in the increasing attention which is being directed towards perfecting our system of elementary education. Professors Bain and Robertson, with Messrs. Spencer and Sully, have devoted much thought upon the theories and practice of Education. The Universities are ready to reward the earnest student of the art and science of education with diploma or certificate. Inspectors of schools, notably Messrs. Fearon and Fitch, have also given the results of their wide experience. Amongst elementary teachers a few have ventured to add their practical knowledge to the general store. The present volume is evidently the work of one who is practically acquainted with the teacher's craft. Viewed as a summary of rules and devices for obtaining successful results, the present work contains a large array of such rules—empirically stated, well

arranged, but badly expressed. The book makes no pretence at originality of treatment; the chief aim, as stated in the author's preface, being to supply those who wish to compete at the various Government examinations in school management, with the material needed for such tests, and also 'to accustom them to the manner of answering the questions.'

Pupil teachers, as well as student and acting teachers, have of late been frequently ridiculed in blue books and the daily press, for the crude mode of expression adopted by them in answering questions. The author of this book offers his aid to all who in future intend submitting themselves to inspectorial criticism. The following selections from the first pages of Mr. Prince's book afford specimens of composition which the teacher of the future will do well not to imitate:—

'Knowledge is not the only requisite required at that time (preface).

'Each finds that if he can only make progress in one subject it is recognised, and is raised accordingly.

'His mind, judgment, and spirit are thus laid openly before them.

'If a scholar does anything that is not what he ought to do.'

In the short chapter on Reading, we have the various methods of teaching to read, enumerated, with a brief statement of the advantages and disadvantages of each method. Pupil teachers are further instructed how to conduct reading lessons in the standards I. to VI. This is perhaps the most valuable chapter in the whole book; it is, however, completely marred by the following slipshod or erroneous expressions taken from pp. 80 to 88:—

'These three stages fulfilled, and the stops indicated as pointed out by commas, etc., results in correct reading, as any one listening would be put into as good a position as the reader.

'Occasionally, as an alternate, the scholars may be required to give an abstract of the lesson.

'Before commencing reading tablets, or books, the first thing to teach them is the words in another form.'

Two or three years ago the following question was set in the teachers' certificate examination:—

'*By what arguments would you impress upon children the evils resulting from (a) wanton mischief, e.g., throwing stones at telegraph wires, etc., (b) petty thefts, (c) bullying?*'

After dealing with the dishonesty involved in injuring that which does not belong to us, and stating that dishonesty leads to distrust, the author, in answer to this question, says:—

'In the case of the telegraph, the damage caused by the stone striking the wires or pots is an expense, and money is required from somewhere or someone to repair the damage. Damage might even be done to such an extent as to prevent the proper working of the wires, causing more serious consequences than the boy would ever think of.'

We question whether a wantonly mischievous boy would be seriously impressed by such arguments as these. One of the students for whose benefit Mr. Prince has written this answer has been highly commended by the Inspector who examined these papers for the following answer:—

'First I would give a lesson to the school on the electric telegraph. I would strive to arouse the interest of the children in the delicate mechanism by means of which they could communicate quickly with distant friends. One of the boys might be allowed to send a message to another boy. I would then show how easily it might be damaged, and by these means endeavour to enlist the co-operation of the class in the protection of the telegraph wires.'

We certainly prefer the answer given by the student to that suggested by his self-constituted instructor.

In the chapter on Writing, all goes well until an attempt is made to write the word 'MANAGEMENT' in Mulhaüser's Rhomboids. Let this specimen of writing be compared with those in *The Manual of Writing* published under the sanction of the Council Office, 1849, and almost every letter is faulty in construction. The class subjects are taught on sound methods, but why refer to Macmillan's Science Primers for the method of teaching the *Seasons?* Can this subject be taught Standards II. or III.? What is the result of the author's experience? We should like to know. The preface states that all the methods herein advocated 'have been *tried*, *tested*, and proved successful."

What amount of success would follow the attempt to teach a junior class the following for a first lesson in grammar:—1. Sentence. 2. Names of things. 3. Names of qualities. 4. Names of actions. If these form too much material for a first lesson, what is to be said of the 'Notes of a first lesson on a noun,' pp. 218 and 219, in which, 1. The definition of a noun. 2. Kinds of nouns. 3. Definitions of proper noun, common noun, and abstract noun are all to be taught, written on the black-board, and then committed to memory by the children; and as a conclusion to the lesson, the class is to write out all the proper, common, and abstract nouns from a page of an ordinary reading-book in columns on their slates.

We hold that in this lesson there is ample material for at least half-a-dozen lessons to those beginning the subject.

The book will be of service to head teachers, who are able to select what is good, but it should not be put into the hands of pupil and student teachers.

Latin Grammar and Composition for London University Matriculation. By William Dodds. 68pp. London: W. Stewart.

It is very amusing to note how every cram author begins his book with an earnest protest against cramming, after vigorously enunciating which, he will proceed to inform you that though all previous geniuses who have tried the style, have fallen into this pernicious vice—here again will come a neat little selection of adjectives describing the detestability of cramming—his book is entirely free, *his* intentions being purely and simply the welfare of the student. Mr. Dodds is too old in the trade to make all these statements at once, and yet, even with his vast experience, cannot refrain from the following admission, made with charming frankness:—'The present treatise is intended to be used with, and not in the place of, textbooks; our object being rather to guide and direct, etc., etc., and to throw in such useful hints and suggestions as an experienced tutor, placed at his elbow, might be supposed to give him, etc. etc.' Now, Mr. Dodds knows very well that although he does thus inform the student of multitudinous praiseworthy desires on his part, said student will not give him a word of thanks unless the book shall have succeeded, where all others have some nineteen or twenty times failed, in getting a 'scrape second.' Mr. Dodds knows also that if the student were plucked, one probable result would be the burning of 'Matriculation Latin' in sheer disgust; and if he passes, a very possible result would be the same fate for the book, this time in sheer disdain. It would have been an excuse, we admit, if the London Matriculation Latin, which, it would seem, is an utterly distinct thing from Cicero's Latin, possessed any special merits of its own. But the authorities in Burlington Gardens have not unfrequently been known to be beautifully indefinite. Their questions now and then resemble a notable query on Scripture History which we once heard an Irish examiner put to a class too dull to recognise, even if they ever knew it, the episode of Benaiah and the lion, 'Who killed what on a snowy day?' This being the case, such a collection of questions as the present can scarcely demand permission to stand on their own merits.

But let us look for a moment at our author's pretension to help the student in his reading. As a logical consequence, from this pretension we must form one of two conclusions—either that all previous books were unadapted for reading, or that they contained *too much* for the Matriculation. The first conclusion is *a priori* absurd, while the second is indeed pitiable. For what does this second mean? Cramming, in the essence of it, and cramming the less excusable and the more dangerous because so ingeniously cloaked.

We must not, however, be understood to hint that Mr. Dodds' part of the work has been done in a journey fashion. On the whole it is carefully compiled, and with one or two striking exceptions, correctly. Now and then, as we might expect, the English is simply not English. This,

however, is fast becoming the rule with educational books, and is therefore partially excusable by precedent. But cannot Mr. Dodds see that his system will inevitably ruin just those whom it was intended to help, while it would do no harm to those whom it will never reach? Poor struggling workers who aspire to Matriculation may possibly be helped in a lame fashion to the object of their aspirations, but are they a whit the better for it? A life-buoy is very useful, indeed, to keep people from drowning, but is scarcely a good teacher of swimming.

Punishments in the Olden Time. By William Andrews. London: Stewart and Co., Holborn Viaduct.

Modern educators seem averse to punishment, at least to most kinds of bodily pain inflicted with a remedial design. Many regard the practice of former days as spoiling both the rod and the child, and altogether public sentiment would not now countenance the severities of the Busbys of a former generation. In dealing with adults, the law has been gradually and persistently relaxed up to the middle of this century, when the unusual prevalence of garrotting and similar dastardly outrages, induced the legislature to re-enact a modified return to the lash. Nearly all implements of pain or bodily confinement are now abandoned, including the village *stocks*, pretty well remembered, but very seldom to be seen, and certainly never used. Some thirty years ago, the stocks of the royal village of Kew were kept in good repair, but being left unlocked, the upper part was wrenched off and cast into the Thames. Nothing was done to repair the injury, and the other portions were at once removed, and are now almost gone from remembrance. Other old-fashioned engines of punishment have shared the same fate, and are now and then preserved as relics of the past. The brank, a framework of iron for the head, and having a cutting projection that was placed in the mouth to prevent the tongue being moved, is preserved in the vestry of Walton Church, near Weybridge, and bears the date of 1633. The preservation of such horrible implements teaches us that we have indeed made some progress, notwithstanding our shortcomings, and that a poor miserable woman, whose sole offence consisted in raising her voice against a brutal and besotted husband, was led by the parish beadle, with this iron cage upon her head, to the pillory, whipping-post, or market-cross, there to be subjected to every insult and degradation. Mr. Andrews has taken the pains to collect and give drawings of many of these implements of torture, some of which are of fiendish design. It may show the spirit of barbarism that formerly prevailed by the fact that several of these disgraceful implements were for the maltreatment of women. Of this the ducking-stool, of which one remained up to a comparatively recent date at Broadwater, the mother-parish of Worthing. The drunkard's cloak was among the least painful of all; it consisted merely of a tub, or cask, with holes at the sides for the hands to project, and also one on the top, above which the head emerged. The most common of these implements of punishment, however, was the pillory, provided by law in most corporate towns. This means of punishment was not removed from our statute-book till the year 1837. Among the most noted personages placed in the pillory were the infamous Titus Oates and the famous Defoe. The latter obtained the sympathy of the populace so as to be pelted with the complimentary missiles of flowers! Another notable name associated with the pillory is that of Benjamin Keach, a predecessor of the Rev. C. H. Spurgeon, who was put in the pillory for publishing 'The Child's Instructor,' a little primer! What a change has taken place regarding education! Mr. Andrew's book is carefully compiled and suitably illustrated.

How to Teach the New Testament. By Charlotte Mary Yonge. London: National Society.

This little book forms one of the 'Religious Knowledge Manuals' of the National Society. Miss Yonge has an evident sympathy for children, and knows how to win their attention as well as their affections. The spirit in which her directions, or rather suggestions, are made, is admirable and free from the dogmatic tone which teachers of religious lessons frequently adopt. Her object is wisely to imbue little ones more with the spirit than the letter of Scriptural lessons. Her course for infants is judicious, and the little specimen lesson admirable. But we question the wisdom of learning 'by heart,' as it is called, a great number of hymns—in fact, some verses to every lesson. Doubtless, the memory of infants may be occasionally exercised, but only occasionally, and far less, we think, than is generally done. But the learning of even one verse together with a portion of a hymn is more than should be exacted from little children. The use of pictures and other means of engaging the attention is wisely recommended, and the advantage thereby derivable pointed out in the course of the specimen lessons. This learning by heart is so highly regarded by Miss Yonge that she recommends 'If possible, the Sunday Gospels should be learnt by heart; but if any other plan be adopted, this age (that next to the infant period) is a suitable one for making the children learn the Parables and the Sermon on the Mount.' We hope some other plan will be adopted than this 'making' of children do any thing of the kind. The wondrous beauty and simplicity of the Sermon on the Mount will involve no oppressive effort on the memory, but we should hesitate in taxing the powers of young children to half the extent thus recommended. Most cordially do we agree with the authoress as to the value of good poems in giving zest to a lesson to children of both sexes and all ages, who 'will listen to them with great pleasure, and carry off an impression far more vivid than if left to the teacher's endeavours at description.' Most true, and of course not to be understood as discouraging all efforts at explanation on part of the teacher, but making such efforts effective by the highest truths being expressed by the best writers in the best way. The higher course of teaching the more advanced scholars is thoroughly developed by Miss Yonge, and her explanations of the various points of the Gospels and Epistles, together with the course of teaching suggested, most ably and carefully shown. The devout, yet loving spirit of such a teacher as Miss Yonge, cannot fail to win the heart as well as to stimulate the intelligence of every pupil who is benefited by such efforts. Those who carry out—and the work involves much reading—the course recommended by the authoress cannot fail, if working in a proper spirit, of becoming useful and, we hesitate not to add, *good teachers*.

We are sorry to notice that one of the reasons urged for the teaching of infants in Church Schools, is lest they should go to schools conducted by Dissenters. We say nothing on the exceptionally bad taste of such a remark, beyond expressing our regret that it should have been made.

Great Englishmen: Short Lives for Young Children. London: George Bell and Sons.

The rather awkward title we thought might be amended to 'Short Lives of Great Englishmen,' and with this our disposition to find fault ceases. The sketches of about a score of the most famous Englishmen are simple and explanatory—being thus adapted to junior readers—yet remarkably well done; in many cases the description rises to true eloquence that is none the less effective though couched in a simple style. The descriptive details are well relieved by occasional dramatic touches, such as the following on Caxton:—'Caxton worked on till he was nearly eighty, and he worked up to the day of his death. He was not slumbering when his call came; he was still labouring at the work for which he was born. . . . . It was eventide, and the sun was sending its last red streaks of light into the little workshop of Westminster, when four workmen entered, clothed in black, and looking grave, sad, and downcast. The room looked deserted; papers lay about; the ink-blocks were dusty;

a thick film had formed on the ink; the machinery looked oily and unused. The four men drew in their stools on which they had sat through many a long day of quiet labour, steadily working to the distant end of some manuscript—working for their master, who would now no more direct their work and encourage them to the end.

'"Companions," said one, "this good work will not stop."

'"Who is to carry it on?" sadly asked another.

'"I am ready," answered the first speaker, whose name was Wynkyn de Worde.

'A cry of joy rose to the lips of the honest workmen, but it faded again as they thought of him they had lost.'

Equally affecting is the brief sketch of the death of Harold, 'who had made himself very dear to his people, and spared no pains to make them happy':—'Harold, the son of Earl Godwin, the last of the Saxon kings, the man who died fighting for the land and the people he loved so well, was buried beneath a heap of stones on the "waste sea-shore." For "he kept the shore while he lived; let him guard it now he is dead," said William. And the English wept long and bitterly for their king.

'"Oh, Harold, Harold!
Our Harold, we shall never see him more!"'

The stories of Nelson, Wellington, Stephenson, and other worthies are told equally well. Our only regret is that we have no more room for quotation. Much in the way of history will be most strongly impressed on the memory by the reading of this book, and its effect on the minds of youthful readers cannot for a moment be doubted.

An Easy and Rapid Method of Acquiring a Thorough Knowledge of the Latin Verbs.

48 pp., sewn. Glasgow: David Wilson.

We confess we were under the impression that no rational being could find a difficulty in his Latin verbs, but we fear we must abandon this long-cherished notion in favour of our anonymous author's proposition that most boys do. Admitting even this, we cannot see the necessity for the present book. We are sorry in any case to give this verdict upon a humble little work that can do no one any harm, but particularly when it is so carefully prepared as the present. There is no novelty in the arrangement, no particular attractiveness in the details. We plod through our terminations, the twenty-third page sees us actually at work; the thirty-sixth page lands us at irregular verbs, and the five last pages are a list of anomalies. The chief merit in the book is that this list of anomalous verbs is arranged anyhow, so that the learner cannot learn a verb by its position on the page; the chief defect is that nothing is said about compound verbs. It would not be hard to pick out defects, but this almost goes without saying, considering that there are some verbs upon which no two Latin grammars agree. On the whole we doubt the general soundness of a principle which supplies the student with note-books and 'Short and Easies,' or 'Easy and Rapids.' No notes are worth having unless compiled by their owner.

The Kindergarten.

Being a selection of Lectures read before the London Froebel Society. London: Swan, Sonnenschein, and Allen.

We must plead ignorance to much connected with teaching children how to play on scientific principles, and telling stories to them with some profound æsthetical or symbolical meaning in our words or tales. We confess also to be as completely bewildered at the sight of the recondite design, nicely packed, like one of Mr. Murray's maps, in a sort of sheath inside cover of the book, which reminded us of the mystery of a Freemason's apron. Our early efforts, as in teaching, were mainly directed to keep little children from playing and induce them to attend to our less attractive books and lessons. In all this we were doubtless wrong, and should have possibly avoided such errors had we been taught 'Jack and the Bean Stalk' on the Kindergarten principle. And now having made this honest avowal, let us speak of the great pleasure we experienced in reading the essays in the book before us. Miss Emily Shirreff, whose admirable educational essays we remember,* begins this book with paper on 'Progressive Development.' In this we realized the force of the writer's remark, 'To few is it given to reach these serene heights;' and not being one of those few who see much difference in letting little trots make mud-pies or lumps of clay into spheres or into cubes—*i.e.*, into marbles or into brick-bats—we left this *arcana terrestria* to ponder over the many plain and excellent educational suggestions contained in this and the other essays. Among these, Miss Hoggan gives many admirable hints on the physical education of girls. In this a reform in dress is, we rejoice to say, insisted upon, especially in avoiding compressing the waist, and the modern monstrosity of high-heeled boots. Exercise for girls is no less wisely shown to be essential to health, and also wherein it should differ from the more violent efforts which boys may undertake with impunity. We regret that we have no space also to allude now to the thoughtful paper by Miss Buckland on 'The Happiness of Childhood,' but hope to allude to this before long. The following will be suggestive to every thoughtful teacher:—'God only teaches what the mind can receive; Christ, the Great Teacher, reserved the most important truth until His disciples could receive it; but the minds of little children are often loaded with a mass of unintelligible religious teaching, beneath which they shrink oppressed and discouraged. It is this forcing of everything at once upon a child before he can grasp it, that often makes religious teaching a misery rather than a joy.' Again—'Let the thought of God be first associated in the mind of a child with all the good gifts and blessings of life, but not with its catastrophes and terrors. A little child was told that the thunder was the voice of God, and this at once provoked the remark, "Then I don't love God at all, and never shall." Too often the representation of God to little children has been such as to produce fear and misery, rather than love and happiness.' We fear that we have all much to answer for in this way, and hope we have said enough to show how worthy of attention this little book is, whether we mould our lumps of clay into round balls or 'on the square,' as the song sayeth.

The Canal Boy who became President.

By Frederick T. Gammon. London: S. W. Partridge.

Few books are more deservedly interesting to all connected with education than the above, which traces the course of the lamented President Garfield from the cradle to the grave. Most readers are acquainted with the main features of the life of this distinguished man, from the numerous newspaper accounts which his illness and death called forth. The life, however, of such a man cannot be too often told, and in the little book before us it is well told. Although called the canal boy on account of his youthful employment, yet James Garfield was mainly celebrated for his success as a student, teacher, and classical professor of the Hiram Institute, of which he was soon elected President. Here he taught and ruled over 300 students with signal success. One of the students speaks of the 'admiration and love' felt for Professor Garfield as having 'never abated, and the like of which I shall never know.' Schoolmasters may well be proud that a man altogether so pure and worthy belonged to their class. He gave up literature to enter upon a military career at the fierce contest in 1861. As a soldier his success was no less marked than his collegiate career, and on being raised to the rank of major-general, he was elected to a seat in the Congress at Washington. His military knowledge and general ability were regarded as indispensable to the government of President Lincoln, and thus General Garfield became famous as a states-

* Especially an excellent collection of essays entitled, 'Why should we Learn?'

man. His success as an orator and administrator are well described by Mr. Gammon, together with the touching scenes of his lamented death. We have thus indicated a few of the leading incidents of the career of this self-made man, with the desire that Mr. Gammon's well-written narrative may be extensively read.

Walker's Elementary Atlas of Modern Geography. London: John Walker and Company, Farringdon Street.

This little sixpenny atlas contains sixteen coloured maps, one of which is a remarkably useful one of the physical features of the British Isles. In this the plains—in light yellow tint—are seen at a glance, as well as the hills (light blue), and the granite formation in red. We could wish the tint of the mountains were more distinguishable from that of the sea: these being identical give an impression of the sea penetrating inland—in fact, where the mountains are situated. Good use is made of the covers, each page of which contains useful explanatory diagrams.

A Poetical Reader; (Longman's Modern Series.) For the Fourth Standard of Elementary Schools. Selected by James Booth. London: Longmans, Green and Co.

This well-printed and beautifully illustrated book of poetry contains a goodly selection of old favourites by Milton, Campbell, Scott, Burns, Byron, Goldsmith, Macaulay, and other leading authors, together with several modern ones of unquestionable merit. These latter include Hood's 'Dream of Eugene Aram,' now justly regarded among the classical gems of English poetry; a spirited description of the Queen's receiving the news of the fall of Sebastopol, Kingsley's 'Three Fishers,' Douglas Jerrold's touching lines entitled 'The Drum,' some beautiful verses on 'Sir John Franklin,' and several equally meritorious pieces by anonymous authors. The entire selection is marked by good taste and appropriateness to the higher pupils of elementary schools. Generally, the pieces are of a serious, many of a deeply pathetic character; but these are relieved by a few humorous ones selected with equal care and judgment. A few brief explanatory notes are appended, and a short biographical introduction placed at the beginning of the known authors of the extracts that follow. The illustrations are plentiful, appropriate and remarkably good. Few better specimens of wood engraving can be found than many that grace this little collection. Among the most beautiful of these is that of the Bell Rock Lighthouse, the simple yet wondrous curling wave and watery expanse at the head of Byron's lines on the ocean, the view of Dover, and more particularly an exquisite little picture of a soldier dying in the snow, while his comrades pass mournfully on; the snow weighing down branches of the tree over the fallen soldier's head is most effective. Very sweet and also suggestive is the heading to Milton's 'L'Allegro,' representing a milkmaid bearing her pail on her head, and at the side a shepherd counting and penning his sheep under a tree, thus aptly suggesting the explanation of the well-known, but often misunderstood lines:—

'And every shepherd tells his tale
Under the hawthorn in the dale.'

For elementary schools the book should be more strongly bound.

Ludgate Hill: Past and Present. By W. P. Treloar. London: Griffith and Farran, St. Paul's Churchyard.

Mr. John Bright, in his recent speech at Rochdale, said that he had lived in London for six months in the year during the last forty years, and yet knew nothing of the great metropolis. We venture to say if he will read Mr. Treloar's book that he will learn therefrom something about Ludgate Hill. Pleasant reading, too, withal, and by no means dogmatic. Mr. Treloar introduces us to the mythical King Lud, whose effigy—together with that of a son on each hand—was pulled down with the rest of the structure of the old prison in 1760, after being stowed away for some years in the bone-house of the adjacent St. Dunstan's Church, was taken away by the Marquis of Hertford (Thackeray's Marquis of Steyne) to his villa in Regent's Park. From this shadowy period we are taken through what vestiges remain of Roman London and the very few British features. Saxon London was, as Mr. Treloar remarks, 'Roman London despoiled, but growing yearly richer in the commerce planted by the former invaders.' The truly dark period that marked the struggles of the early Teutonic settlers was ended by the introduction of Christianity, followed by the cohesion of the Heptarchy into the single Government of Egbert. London continued to make progress, though slowly, till the advent of Canute, who greatly improved and strengthened the place. When the Normans came, London was fully entitled to be looked up to as the metropolis of the kingdom. We are then led by Mr. Treloar through Bridewell, and among other notable surroundings of this central part of the old city, giving us snatches of history where suitable, and instructive gossip that is by no means out of place. Of course, much of the general history of London is dipped into in accounts of the Churches of St. Paul; the River Fleet and its prison; the Great Fire and the Plague; the establishment of the booksellers in Paternoster Row after the Great Fire, when this locality was created by the mercers, lacemen, milliners, and tire-women. We are treated to a view of Ludgate before the removal of the prison on the spot now crossed by the ugly railway-bridge; next to a picture of Ludgate Hill towards the latter part of the last century; and finally, by way of frontispiece—if we may so express it—of the Hill crossed by the said hideous railway-bridge, across which a locomotive in full steam is seen. Much more we would add to express the pleasure this book has afforded us.

A Glossary of Biological, Anatomical, and Physiological Terms. By Thomas Dunman. London: Griffith and Farran.

To students of botany, physiology, and general science, this Glossary will be most welcome. It contains a goodly number—161 pages—of scientific terms, boldly printed so as to attract the eye, accentuated for pronunciation, and alphabetically arranged. These words, after being traced to their Greek or Latin sources, are explained concisely, yet sufficiently for all purposes required by the student. This book will save the student much trouble in tracing scientific terms, and also save many scientific text-books from being encumbered with such explanatory verbalisms.

The Boy's Own Toy Maker. London: Griffith and Farran, St. Paul's Churchyard.

While we are straining our wits how to teach and what to learn, we should do well not to neglect the teaching of how to play. Boys and girls teach each other much in the way of games and sports, it is true; but even then the old adage holds good that all must have a learning. It is mostly in the way of teaching boys and girls how to amuse themselves indoors during winter evenings as well as out of doors with kite, bat and ball, angling, and the like, that this little book is written. In it we have directions how to make good use of a pair of scissors and a sheet of paper. Add to these a sheet of cardboard and a bottle of gum or glue, and wonders may be wrought in the way of rustic cottages, boats, puzzles, and an endless succession of toys whose symmetry is much secured by their being cut in a duplicate or folded position. Add a few tools, including a fret-saw, and a new sphere for ingenuity is opened. With a few inexpensive and harmless chemicals many interesting and truly instructive experiments may be performed, as the little book before us explains. The process of producing copies of wax impressions in electrotype may be carried out with the aid of very simple apparatus. By equally inexpensive and simple materials the field of

optics, electricity, and other physical sciences may form matters of common employment for leisure evenings. We say nothing of the knowledge of science thus to be gained. Indeed, we would rather keep this out of sight. It will make its own way most surely, and perhaps the more so by the object being understood to be that of amusement. The directions given in this little volume are clear, and easy to be understood. Who can doubt but that a taste for intelligent skill will be developed by inducing amusements of the kind herein described? Many old numerical and other puzzles, such as the nun's expedient to make up the number nine on each side of the square; the puzzle of the two fathers; puzzles double; puzzles single; puzzles with glasses; and puzzles with coins: all suggesting, or capable of being made suggestive, of some philosophical principle. Surely by such means idle or worse kinds of play may be eliminated.

Hofer, the Tyrolese. By the Author of 'Claudine, etc. London: Griffith and Farran, St. Paul's Churchyard.

The character of Hofer has suffered not only from the acerbity of the French, but from the petty jealousy of Austrian writers. But the purity of his life and persistent devotedness in defence of the liberties of his country have been very generally acknowledged, and are in this affecting little narrative cleared from all shadow of stain. The abandonment of the brave patriot and the people of the Tyrol by the Austrians was the main cause of the success of the French. But Hofer yielded not, nor would he have been taken but for his determined efforts to rescue his beloved wife from the hands of his enemies. These efforts led to his betrayal to the French. Napoleon was not the man to forgive so successful a patriot. Hofer was condemned to be shot, and no stain is greater on the name of Napoleon than this *murder* of Hofer. True his name lives in the Tyrol, as that of Washington does in America. 'Justly,' says the writer of this little sketch, 'is he regarded as the saviour of his country.' The struggles, victories, and exemplary conduct in restraining excesses are described by the author with remarkable power, considering the condensation of the narrative. At the famous battle of the 12th of August—the Bannockburn and Bunker's Hill of the Tyrol—the Bavarians were alarmed while in the defile of the Isel Mountains at the sounds of a voice from the heights above. 'To return was impossible, to halt was madness—all rushed forward. Once more the deep silence of the terrified assailants was broken by two simple, but appalling words—"For Tyrol." For an instant all was deadly stillness: the appalled enemy gazed on each other with pallid cheeks and haggard eyes. Another instant, and rocks, trees, and stones are wrenched from the borders of the ravine, and fall upon the foe with overwhelming force. From behind every cliff and bush starts forth an armed Tyrolese. It is a pursuit, and not a battle; a flight, and not a combat. Boys and girls join in driving the enemy through the pass. Hundreds were taken prisoners; thousands slain. When the victory was completed the mountaineers fell on their knees, and returned thanks to God for the deliverance of their country. So awful and so sudden had been the work of extirpation that the bewildered prisoners joined in the act of prayer!' These are stirring words, and by no means exceptional to the spirited narrative before us. The facts are stated on the authority of Kotzebue's narrative and the 'Edinburgh Annual Register' for 1810.

Peter the Whaler. By W. H. G. Kingston. London: Griffith and Farran.

No book written by the lamented Mr. Kingston has become more worthy of popularity than *Peter the Whaler*, of which a copy of the twelfth edition is now before us. We need say nothing in regard to the merits of Mr. Kingston's ever-fresh and ever-welcome books. He had the knack of keeping up attention without sensational excitement. His narratives are natural yet interesting, and the moral never unduly thrust forward. Messrs. Griffith and Farran have clothed this edition of Peter's adventures in an attractive binding.

A Gem of an Aunt; A Story in Short Words. By Mary E. Gellie (M.E.B.). Griffith and Farran.

Mistress Mary E. Gellie laid out for herself no slight task in undertaking to tell a sustained tale in monosyllables. The same feat has been successfully accomplished by Miss Sarah Crompton, of Birmingham, in her story of Robinson Crusoe, and by others. To the list of successful books for very young readers we must add the volume before us. This opens with a call from Aunt Bell, and an offer on her part to take her nieces and nephews, a little group of five, to the seaside. The offer being, of course, accepted, we have a pleasant record of the holiday, of the young folks' delight at the sea, and their little adventures in country excursions, with pleasing descriptions of country objects and scenes. We have a fair supply of little tales by way of relief from Aunt Bell herself, who winds up with a very pretty story of 'The Twins.' We will not mention the word lessons in relation to this nice little book, but its words and ideas are within the scope of young beginners, who, we doubt not, will be charmed to have the paths of knowledge made thus smooth and attractive.

Poetry for the Young. 128 pp. London: Griffith and Farran.

The only fault (and we own it is a very pardonable one) we have to find with this book is the binding. Doubtless the publishers thought this volume would command a special sale as a prize at this season of the year; we hope it may. But for the ordinary wear and tear of school work, it certainly should be clad in a more serviceable dress. Of the book itself, we have no complaint to make: the selections, type, and paper are admirable. We do not think any teacher who buys 'Poetry for the Young' will regret his investment.

Our Little Ones. Vol. II. No. 1. London: Griffith and Farran.

If we are not mistaken, this is an American periodical, re-issued in the mother-country to find favour in the eyes of her little folk. The illustrations, which, to many children are the chief attraction in a book of this kind, are faultless, and (we are sorry to have to make the confession) put into the shade the workmanship of our best English houses. The literary work is also well done. 'Our Little Ones' is sure to be a favourite.

Our Little Ones. No. 2, vol. II. Griffith and Farran, London.

This number is illustrated with care, taste, and in point of merit is not behind its predecessors.

Rhymes in Council. Aphorisms Versified. By S. C. Hall. London: Griffith and Farran.

'In the eighty-first year of my age I write these verses. They are the outcome of knowledge, based on experience, and matured by thought: the proceeds of *a long life*.

'A few dotted down reflections have grown into a book.

'I bequeath them as a legacy to my kind—with humility, but with faith, hope, trust, and love.

'May they, by the aid and blessing of God, bear fruit.'

So read the opening sentences; and what more need we add except that the worthy veteran has succeeded in his effort. Messrs. Griffith and Farran, in publishing the work, have spared no pains to entitle it to a place on any drawing-room table.

Holly Berries. With Original Illustrations. By J. Waugh. London: Griffith and Farran.

This is a volume of rare beauty, described on the wrapper as 'the gift-book of the season.' Exquisite taste has been shown by all concerned in the production of it. Miss Waugh's admirable drawings are beautifully printed in colours. We hope these 'Holly Berries' will brighten up the homes and gladden the hearts of thousands of our young friends this coming Christmas.

Johnston's First Grade Freehand Test Papers, containing 24 different designs. London: W. and A. K. Johnston.

We have pleasure in drawing attention to these designs, now that the general Drawing Examination will soon be upon us again. The copies are clear, graceful, and progressive. They possess one special merit that should not be overlooked in the country school, where rigid economy has to be practised, and that is, the designs are so arranged that after the book has been filled by the pupil, they can be cut out, mounted and used as ordinary drawing cards. We gladly recommend the book.

Roach's Practical Examiner's Arithmetical Tests. For Standards 2 and 3. London: T. Murby.

These two sets of cards furnish excellent arithmetical test work for the Standards for which they are designed. Each packet contains twenty-four cards and two copies of answers, which are enclosed in an attractive cloth case. The way in which the answers are mounted deserves a special word of praise.

The Analytic Test Cards. In three Packets. By R. S. Wood. London: J. Marshall and Co., Paternoster Row.

These cards deserve to have a wide circulation. Next to arithmetic there is perhaps no subject so unsatisfactorily taught as English composition. To the teaching of this subject Mr. Wood has evidently paid special attention. These three packets of cards, adapted for pupil teachers and the higher standards in our elementary schools, embrace no less than three hundred different subjects. The questions have not been set down haphazard; they are suggestive, comprehensive, and practical. As an instance of the way in which a young beginner is helped, we transcribe the first question on one of the cards now before us:—

'Write all you know of the cotton plant, under the heads (1) The appearance of the plant, (2) *Where* and *how* grown, (3) The cotton-fields, (4) *How* gathered, (5) *Where* it is sent, (6) *How* and *where* it is manufactured, (7) What it is made into, (8) Its *uses*.'

We hope the Analytic Test Cards will meet with the patronage they so well merit.

Longman's Quarterly Arithmetical Tests For Standards 2, 3, 4, 5, and 6. London: Longmans and Co.

These new candidates for public favour present a remarkably neat appearance. On each card there are twenty questions, divided into four quarterly progressive examinations. The advantage of this arrangement must be apparent and commend itself to every practical teacher. The questions furnish the means of testing a child's progress at almost any stage. We heartily commend the series to the notice of the profession.

Universal Instructor. Part 14. London: Ward and Lock.

This periodical is as usual full of valuable matter, and well illustrated.

The Midland Grammatical Exercise Books for Standards II. to VII. Birmingham: The Midland Educational Company.

These books are neatly ruled according to the most recent requirements of the new code. They will ensure neatness of work and save the teacher much trouble. The prices at which they are issued are very moderate.

Agonic-Eyed Needles: Manufactured by S. Thomas, Redditch.

A clever sempstress, who has used these beautiful needles, gives them high praise. They are easy to 'thread,' and exceedingly pleasant to use.

Publications Received.

Arithmetic—

(1) Roach's Practical Examiner's Arithmetic Tests. T. Murby.

Drawing—

(1) First Grade Freehand Test Papers. W. and A. K. Johnston.

German—

(1) Quick's Essentials of German. Longmans, Green and Co.

History—

(1) John's History of England. W. Isbister.

Latin—

(1) Fyfe's Easy and Rapid Method of Learning the Latin Verb. D. Wilson.

Miscellaneous—

(1) Sonnenschein's Foreign Educational Codes. W. Sonnenschein and Co.

Periodical Literature—

(1) Ward and Lock's Universal Instructor. Part XIV. Ward, Lock and Co.
(2) Our Little Ones. No. II. Griffith and Farran.

Prize Books—

(1) Gammon's Canal Boy who became President. S. W. Partridge and Co.
(2) Norris's Early Start in Life. Griffith and Farran.
(3) Robson's River Singers. Bemrose and Sons.

Scholarship Examination, 1881.

MALE AND FEMALE CANDIDATES.

Dictation and Penmanship.

Twenty Minutes allowed for these Exercises.

Candidates are not to *paint* their letters in the *Copy-setting Exercise*, but to take care that the copy is clean and without erasures.

Omissions and erasures in the *Dictation Exercise* will be counted as mistakes.

The words must not be divided between two lines; there is plenty of room for the passage to be written.

Write in large hand, as a specimen of Penmanship the word *Contemplation*.

Write in small hand, as a specimen of Penmanship, the sentence—*Still glides the gentle streamlet on.*

Dictation.

Write the passage dictated to you by the Examiner, and punctuate it correctly.

[We regret that owing to a printers' error the price of the quarterly subscription to the *Schoolmistress* newspaper was quoted wrongly in our last issue. It should have been 1s. 9d. instead of 1s. 3d.]

Query Column.

☞ **As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'**

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. Replies will not be sent through the post.

4. Correspondents are requested to write *legibly*, and on one side of the paper only.

5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.

6. Queries must reach the office *not later than the 15th of the month*, or they cannot be attended to in the following issue.

⁂ All communications for this column should be addressed

'The Query Editor,'
The Practical Teacher
Pilgrim Street, Ludgate Hill,
London, E.C.

Arithmetic.

1. DOUBLE GLOSTER, Cam.—

(*a*) In what time will £400 amount to £467 18s. 10·42d. at 4 per cent. comp. int.?

(*b*) At what rate per cent. will 70 guineas amount to £114 16s. 10½d. in 2 years at comp. int.?

(*a*) £467 18s. 10·42d. = £467·943416̇.
Amount of £1 at end of required time =
£467·943416̇ ÷ 400 = £1·1698585416̇.

Now amount of £1 for 1 year at 4 per cent. = £1·04; and if we multiply this (1·04) by itself until we obtain 1·1698585416̇, we shall readily see the answer.

$(1·04)^4 = 1·16985856.$
Hence required time = 4 years.

Amount of £400 for 4 years at 4 per cent. comp. int. = £467 18s. 10·42416d.

(*b*) £114 16s. 10½d. = £114·84375.
70 guineas = £73·5.
Amount of £1 at end of 2 years = £114·84375 ÷ 73·5 = £1·5625.
Now $\sqrt{1·5625} = 1·25$.
∴ Amount of £1 for 1 year = £1·25.
Interest on " " = £¼.
∴ Rate per cent. ... = ¼ of 100.
= 25.

Note.—When the given time is 3 years, 4 years, etc., the cube root, 4th root, etc., must be taken. The 5th, 7th, and similar roots would be calculated by Logarithms.

2. R. B. P.—The expense of constructing a railway is £2,000,000, of which ¼th part was borrowed on mortgage at 5 per cent, and the remaining ¾ths was held in shares; what must be the average weekly receipts so as to pay the shareholders 6 per cent., the expenses of working the railroad being 45 per cent of the gross receipts? (*Barnard Smith.*)

Interest on mortgage = 5% on £500,000
= £25,000.
Dividend on shares = 6% on £1,500,000
= £90,000.
Total amount paid ... = £115,000.
Working expenses ... = 45% or $\frac{9}{20}$ of gross receipts.
∴ Amount paid ... = $\frac{11}{20}$ of gross receipts.
∴ Gross receipts = amount paid × $\frac{20}{11}$.
= £115,000 × $\frac{20}{11}$

∴ Average weekly receipts = £115,000 × $\dfrac{\overset{5}{\cancel{20}}}{11 \times \underset{13}{\cancel{52}}}$

= £$\frac{575,000}{143}$
= £4,020 19s. 6¾d. $\frac{123}{143}$q.

3. R. GIBBONS, Stockport.—I sold a certain amount of railway stock at 106, and invested the proceeds in the 3 per cents. at 96. I sold out this 3 per cent. stock at 99, and repurchasing the railway stock found myself a gainer of 80 guineas. What amount of stock did I originally possess?

£ £ £
$\underset{\underset{16}{\cancel{32}}}{\cancel{96}} : \underset{53}{\cancel{106}} :: \cancel{3}$: Gain on £100 of original stock
= £$3\frac{5}{16}$.

£ £ £
∴ $3\frac{5}{16}$: 84 :: 100 : Amount of stock originally possessed
16 16
53)134400
£2535 16s. 11¾d. $\frac{5}{53}$q.

4. X. Y. Z.—A person sold out £296,000 in the 3 per cents. at 91¼, paid 5s. per cent. as brokerage on the amount realized, and £54 15s. for other expenses. He invested the remainder in two equal amounts in New Zealand 5 per cents. and Queensland 6 per cents., increasing his yearly income by £5,070. The price of New Zealand Stock was 102½. What was the price of the Queensland Stock?

Income derived from the 3 per Cents. = £(2,960 × 3)
= £8,880
Amount realized for this Stock = £(91¼ × 2,960)
= £270,100
Expenses = ¼% on £270,100 + £54 15s.
= £675 5s. + £54 15s.
= £730.
∴ Net amount = £270,100 − £730
= £269,370
Income derived from the new stocks = £8,880 + £5,070
= £13,950
" " " " New Zealand Stock
= (½ of £269,370 × 5) ÷ 102½
= £269,370 × $\frac{\cancel{5}}{\cancel{2}}$ × $\dfrac{\cancel{2}}{\underset{41}{\cancel{205}}}$
= £6,570
∴ Income derived from the Queensland Stock
= £13,950 − £6,570
= £7,380

∴ Price of the Queensland Stock

$$= \frac{134,685 \times \cancel{6}}{\cancel{7,380}}£$$
$$1,230$$
$$= \frac{219}{2}£$$
$$= £109\tfrac{1}{2}.$$

5. North.—The gold coinage of one nation contains 1 part of silver to 11 parts of gold, without alloy; that of another nation 1 part of alloy to 23 parts of gold. It is found that 46 of the second weigh as much as 88½ of the first. The intrinsic value of silver is $\frac{1}{16}$ that of gold. Determine the par of exchange.

Gold coinage of 1st nation : gold coinage of 2nd nation

$$:: 88\tfrac{1}{2} \div (\tfrac{11}{12} + \tfrac{1}{16} \text{ of } \tfrac{1}{12}) : 46 \div \tfrac{23}{24}$$
$$:: 88\tfrac{1}{2} \div (\tfrac{11}{12} + \tfrac{1}{192}) : \overset{2}{\cancel{46}} \times \frac{24}{\cancel{23}}$$
$$:: 88\tfrac{1}{2} \div \tfrac{177}{192} : 48$$
$$:: \frac{\cancel{177}}{\cancel{2}} \times \frac{\overset{96}{\cancel{192}}}{\cancel{177}} : 48$$
$$:: 96 : 48$$
$$:: 2 : 1$$

∴ A gold coin of 2nd nation = 2 gold coins of 1st nation.

6. W. T.—Find the increase in annual income produced by transferring the sum of £4,500 from consols at $98\frac{7}{16}$, to the 4½ per cents. at 96¼.

Note.—Consols are at 3 per cent., unless otherwise stated.

Income in 1st case = £(45 × 3)
= £135

$$\left.\begin{array}{rr} £ & £ \\ 96\tfrac{1}{4} : & 98\tfrac{7}{16} \\ £ & £ \\ 100 : & 4\tfrac{1}{2} \end{array}\right\} :: \overset{£}{4,500} : \text{Income in 2nd case}$$

$$\left.\begin{array}{rr} 1,540 : & 1,575 \\ 200 : & 9 \end{array}\right\} :: \overset{£}{4,500} : \quad ,,$$

$$\text{Income in 2nd case} = \frac{1,575 \times 9 \times 4,500}{1,540 \times 200}£$$
$$= £207 \text{ 2s. } 0\tfrac{1}{2}\text{d. } \tfrac{2}{11} \text{ q.}$$
$$\therefore \text{Increase in income} = £207 \text{ 2s. } 0\tfrac{1}{2}\text{d. } \tfrac{2}{11} \text{ q.} - £135$$
$$= £72 \text{ 2s. } 0\tfrac{1}{2}\text{d. } \tfrac{2}{11} \text{ q.}$$

7. M. A. Smith, Chepstow.—What sum will amount to £425 19s. 4⅘d. in 10 years at 3½ per cent. simple interest, and in how many years will it amount to £453 11s. 7d.?—*Barnard Smith.*

£3½ × 10 = £35.

$$\therefore \overset{£}{\cancel{135}} : \overset{£\ \ s.\ \ d.}{425\ 19\ 4\tfrac{4}{5}} :: \overset{£}{\cancel{100}} : \text{Principal}$$

```
  27            20     20
   27)8,519  8  0
     £315 10  8     Ans.
```

```
  £   s.  d.              £   s.  d.
 425  19  4⅘             453  11  7
 315  10  8              425  19  4⅘
 110   8  8⅘      :       27  12  2⅕ :: 10 yrs. : Time
      20                      20
   2,208                     552
      12                      12
  26,504                   6,626
       5                       5
 132,524                  33,131

     132,524)331,310(2½ yrs.     Ans.
             265,048
              66,262
```

8. Lloyd.—A sum of £3,750 was sold out of the 3 per cents. at 95, and put at compound interest for 2 years at 4 per cent.; the amount being laid out in the 3½ per cents. at 104, find alteration in income.

(To be worked by Rule of Unity).

Income in 1st case = (37½ × 3) £
= £112½.

Amount realized by sale of this stock = (37½ × 95) £
= £3562½.

```
            £
         3562·5
  4% =    142·5
         3705·0
  4% =    148·2
         3853·2
```

$$\text{Income on } £1 \text{ in 2nd case} = \frac{3\tfrac{1}{2}}{104}£.$$

$$\therefore \quad ,, \quad \text{in} \quad \text{2nd case} = \frac{3853 \cdot 2 \times 3\tfrac{1}{2}}{104}£$$
$$= \frac{1926 \cdot 6 \times 7}{104}£.$$
$$= \frac{13486 \cdot 2}{104}£.$$
$$= £129 \text{ 13s. 6d.}$$

∴ Alteration in income = £129 13s. 6d. − £112½
= £17 3s. 6d.

Algebra.

1. G. Lamotte, Teynham.—Solve the equations—

$$\left.\begin{array}{ll} (1) & x^2 = \dfrac{39}{y} - \dfrac{14}{x} \\ (2) & y^2 = \dfrac{42}{x} - \dfrac{13}{y} \end{array}\right\}$$

Multiplying (1) by 3:—

$$\left.\begin{array}{ll} & 3x^2 = \dfrac{117}{y} - \dfrac{42}{x} \\ (2) & y^2 = \dfrac{42}{x} - \dfrac{13}{y} \end{array}\right\}$$

Adding :— $3x^2 + y^2 = \dfrac{104}{y}$

$\therefore 3x^2y + y^3 = 104$ (3).

Multiplying (2) by 3:—

$$\left.\begin{array}{ll} & 3y^2 = \dfrac{126}{x} - \dfrac{39}{y} \\ (1) & x^2 = \dfrac{39}{y} - \dfrac{14}{x} \end{array}\right\}$$

Adding:— $x^2 + 3y^2 = \dfrac{112}{x}$

$\therefore x^3 + 3xy^2 = 112$ (4).

$$\left.\begin{array}{ll} \text{Adding (3) and (4)} :— x^3 + 3x^2y + 3xy^2 + y^3 & = 216 \\ \text{Subtracting (3) from (4)} :— x^3 - 3x^2y + 3xy^2 - y^3 & = 8 \end{array}\right\}$$

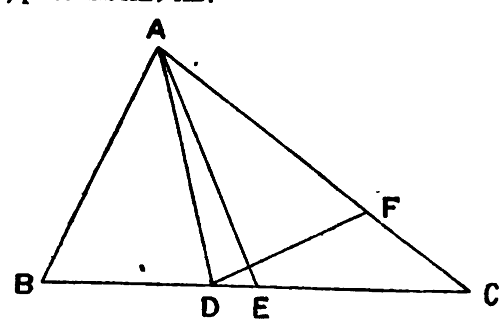
Extracting cube roots—

$$\left.\begin{array}{l} x + y = 6 \\ x - y = 2 \end{array}\right\}$$

$\therefore x = 4$ and $y = 2$.

Geometry.

1. A Subscriber, Nottingham.—ABC is any triangle. AD bisects the angle A, and AE is drawn to E, the middle point of BC; prove that AE > AD.



Let AC be greater than AB.

Make AF = AB, and join DF.

Proof.—FA, AD = BA, AD, each to each, and ∠ FAD = ∠ BAD (Hyp.)

∴ FD = BD (I. 4), and ∠ ADF = ∠ ADB.

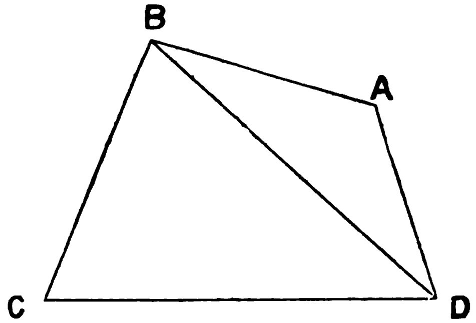
∠ ADB is greater than ∠ AED (I. 16)

∴ ∠ ADF ,, ,, ,,

Much more then is the ∠ ADE greater than the ∠ AED.

∴ AE is greater than AD (I. 19).

2. N. E. Sanderson, Sheffield.—Given the four sides of a quadrilateral figure in order, and the angle between one pair of opposite sides, construct the figure. (*Science and Art*, 1881.)



The sides BA, AD, and the angle BAD being known, the triangle BAD can be constructed.

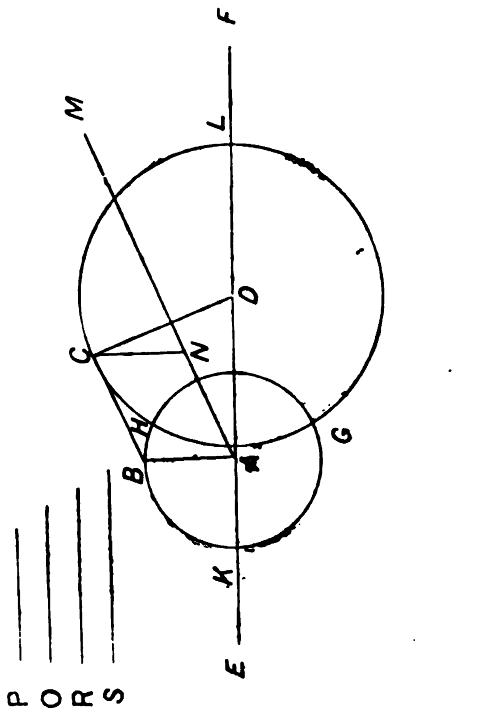
In the triangle BDC, the three sides are known, and therefore it can be constructed.

Thus the quadrilateral figure can be constructed.

The length of the sides BA, AD, and the angle A being given, BD can be found by Trigonometry.

E. CROSS, Faversham.

The above solution was forwarded by the correspondent whose name it bears, but it is *incorrect*, as the given angle is situated between two *opposite* not *adjacent* sides. The correct solution is herewith appended.—Query Editor.



Construction.—Take any straight line EF. Made AD = S. From A with radius P describe circle GHK; and from D with radius = R describe circle GHL. At A make the angle DAM equal given angle. From AM cut of AN = Q; and from N with radius = P describe a circle cutting circle GHL in C. Draw AB parallel to CN, and cutting circle GHK in B. Join CB and CD.

Then ABCD shall be the required quadrilateral.

Proof.—The side AD = S (Con.), and the sides AB, CD = P, R, respectively (Def. 15); Also BC = AN (I. 33) = Q (Con.). Therefore, the quadrilateral ABCD has its sides equal to P, Q, R, S, respectively. Because BC is parallel to AN (I. 33) the angle formed by BC, AD = <DAM (I. 29) = given angle. (Con.).—Q. E. F.

General.

1. X. Y.—Consult the nearest bookseller.

2. A CONSTANT READER.—Articles of special interest to Female Teachers will appear in the new volume.

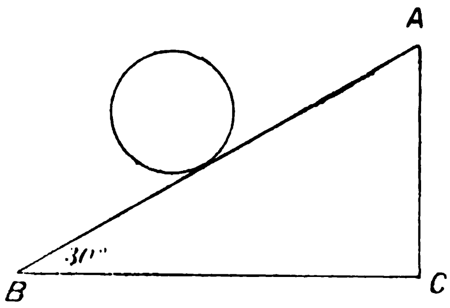
Dr. Smith's series of French and German books are excellent.

3. D. A., Nottingham.—Curtis's History, 5s. 6d.

4. SPHINX, Cornwall.—A sphere of wood, loaded at one end with lead, rests upon a plane inclined at 30° to the horizon, being prevented from sliding down by the friction of the plane.

State and explain by a diagram the condition of equilibrium. (From Matric. Paper).

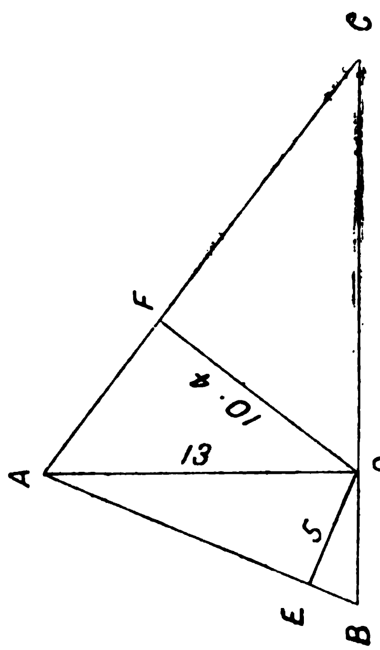
This question is bookwork.



Coefficient of fraction.
$= \tan ABC$
$= \tan 30°$
$= \dfrac{1}{\sqrt{3}}.$

The other will be attended to next month.

5. B. B. S.—ABC is a triangle, and AD is the perpendicular from A on BC. If AD = 13 feet, and the lengths of the perpendiculars from D on AB and AC be 5 feet and 10·4 feet respectively, find the sides and the area of the triangle.—Todhunter's *Mensuration for Beginners.*



$$AE = \sqrt{13^2 - 5^2}\ (\text{I. } 47) = \sqrt{144} = 12\text{ft.}$$

The $\triangle$ ADB is right-angled.

$$\therefore AE \times EB = DE^2 \text{ (See Euclid II. 14).}$$

$$\therefore EB = DE^2 \div AE = 5^2 \div 12 = 2\tfrac{1}{12}\text{ft.}$$

$$AB = AE + EB = 14\tfrac{1}{12}\text{ft.}$$

$$AF = \sqrt{13^2 - (10\tfrac{2}{5})^2} = \sqrt{169 - \tfrac{2704}{25}} = \sqrt{\frac{4225 - 2704}{25}} = \sqrt{\tfrac{1521}{25}} = \tfrac{39}{5}\text{ft.}$$

$$AF \times FC = DF^2$$

$$\therefore FC = DF^2 \div AF = (\tfrac{52}{5})^2 \div \tfrac{39}{5} = \frac{\overset{208}{\cancel{2704}}}{\underset{5}{\cancel{25}}} \times \frac{\cancel{5}}{\underset{3}{\cancel{39}}} = \tfrac{208}{15}\text{ft.}$$

$$AC = AF + FC = \tfrac{39}{5} + \tfrac{208}{15} = \tfrac{325}{15} = \tfrac{65}{3} = 21\tfrac{2}{3}\text{ft.}$$
$$BD = \sqrt{(2\tfrac{1}{12})^2 + 5^2} = \sqrt{\tfrac{625}{144} + 25} = \sqrt{\tfrac{4225}{144}} = \tfrac{65}{12}\text{ft.}$$
$$DC = \sqrt{AC^2 - AD^2} = \sqrt{(\tfrac{65}{3})^2 - 13^2} = \sqrt{\tfrac{4225}{9} - 169}$$
$$= \sqrt{\tfrac{2704}{9}} = \tfrac{52}{3}\text{ft.}$$
$$BC = BD + DC = \tfrac{65}{12} + \tfrac{52}{3} = \tfrac{273}{12} = \tfrac{91}{4} = 22\tfrac{3}{4}\text{ft.}$$
$$\text{Area of } \triangle ABC = \frac{BC \times AD}{2} = \frac{22\frac{3}{4} \times 13}{2}$$
$$= \frac{91 \times 13}{8} = \frac{1183}{8} = 147\tfrac{7}{8}\text{ sq. ft.}$$

6. C. C. J., Great Wakering.—We believe that the particulars of the examination are not yet published. Your query shall be attended to immediately the syllabus is issued.

7. STUDY, Great Bromley.—Pupil teachers have to read at the Scholarship Examinations.

8. J. H., Orkney.—Manford's *Solution of Geometrical Exercises*, 2s. 6d.; Dickinson's *Difficulties of Euclid Simplified*, 1s.; Wollman's *Key to Euclid* (2s. 6d.): *being Solutions to Deductions and Riders Set to P. Ts.*; Mathew's *Deductions from Euclid and How to Work Them*, 3s.; &c.

9. G. BACON, Sheffield.—Your solution to query 43 in last issue is quite correct, and very explicit.

10. ALPHA, Dumfries.—*Chemistry*, Fowne's, 7s. 6d.; Roscoe's, 4s. 6d.
Agriculture.—Stewart's Agriculture; Gill's Agriculture.

11. SUBSCRIBER, Wandsworth.—We are sorry we are unable to give you the information you desire.

12. A. O. E., Carnarvon.—Your solutions to query 42 in last issue are *incorrect*. See correct solution in this number.

13. W. HEMINGTON, Cardiff.—A gas holder 150ft. diameter and 50ft. deep, contains, say, 400,000 cubic feet. What should be the dimensions of a gas holder of the same proportions to hold 300 cubic feet?

(Your question is rather vague, as the first gas holder will hold nearly 900,000 cubic feet, and you do not say whether the 300 cubic feet of the second be the total or proportionate capacity. It is solved on the latter assumption, as on the former the statement of 400,000 cubic feet would be unnecessary).

Cubical content of 1st : cubical content of 2nd
:: 400,000 : 300

$$150^2 \times \cdot 7854 \times 50 : \text{dia.}^2 \times \cdot 7854 \times \text{depth} :: 4000 : 3$$
$$150^2 \times 50 : \text{dia.}^2 \times \text{depth} :: 4000 : 3$$
$$1125000 : \text{dia.}^2 \times \text{depth} :: 4000 : 3$$
$$\text{Dia.}^2 \times \text{depth} = \frac{1125000 \times 3}{4000}$$
$$= \frac{3375}{4}$$

(Now, depth = $\frac{1}{3}$ diameter, as $50 = \frac{1}{3}$ of 150)

$$\therefore \text{Dia.}^2 \times \tfrac{1}{3}\text{ dia.} = \tfrac{3375}{4}$$
$$\tfrac{1}{3}\text{ dia.}^3 = \tfrac{3375}{4}$$
$$\text{Dia.}^3 = \tfrac{10125}{4}$$
$$\therefore \text{Dia.} = \sqrt[3]{\tfrac{10125}{4}}$$

$$\text{Dia.} = \sqrt[3]{\tfrac{20250}{8}} = \frac{\sqrt[3]{20250}}{2} = \frac{27\cdot 2\ldots}{2} = 13\cdot 6\ldots$$

```
                         20'250(27·2...
                          8
  2² × 300 = 1200        12250
2 × 7 × 30 =  420
        7² =   49
             1669        11683
27² × 300 = 218700       567000
27 × 2 × 30 =  1620
         2² =     4
             220324      440648
                         126352
```

∴ Diameter of 2nd gas holder = 13·6...ft.
And depth ,, ,, = $\frac{1}{3}$ of 13·6...ft.
= 4·5...ft.

14. W. GRIFFITHS, Slaithwaite.—In preference to the book you name study Huxley's *Physiography*, the Science Primers written by Grove, Geikie, and Lockyer, in Macmillan's Series. To these add Lockyer's *Astronomy* and Judd's *Volcanoes*.

Owing to the Christmas Holidays, we are compelled to publish the PRACTICAL TEACHER much earlier than usual. This has necessitated several queries being left unanswered. They will, however, be fully attended to in our next issue.

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Health at School.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),

Vice-President of the British Medical Association.

XI.—PHYSICAL EXERCISE—*continued.*

THE VARIETIES OF EXERCISE.

WALKING, leaping, running, rowing, swimming. The muscles which are developed in each kind of exercise might be considered in this part of my subject, but the space at my command is insufficient for the purpose. I might also consider the natural varieties of exercise as brought out in cricket, fencing, football, rounders, rackets, tennis, fives, and even the more plebeian games of leap-frog, hop-scotch, blindman's buff, and the use of the skipping-rope. Each and all are useful in their ways, and should be encouraged in their season. Systematic physical education, by means of gymnastic exercises in which muscles are brought into use in rotation and according to scheme, is undoubtedly beneficial under certain circumstances and in crowded localities where it is impossible to have the use of a proper play-ground; but a school is not properly constituted which has not the use of an exercise ground in correspondence with the number of the pupils. The national games I have mentioned are far superior to any artificial system which has ever been laid down by authority. All that is required is, that exercise shall be brisk, and the respiratory muscles brought fully into action. Appetite is increased by it; more food is assimilated in a healthy fashion than can possibly be the case when no regular exercise is taken; the system becomes properly tired out, and at the end of the day 'nature's sweet restorer, balmy sleep,' gives that rest to the weary which 'nature's soft nurse' is ever ready to afford to those who follow her dictates and obey her behests. I may illustrate the value of systematic exercise by a circumstance which occurred at the Anerley School a few years ago. The school authorities had engaged a drill-master to drill the young urchins who are taken care of in that great establishment. The expenses of the school are paid for by the Boards of Guardians out of the poor-rates of three or four combinations of parochial authorities of some of the parishes on the south of the Thames. The fact of a drill-master being engaged to drill a set of pauper boys was too much for the rate-saving portion of the Guardians, and strong representations were made to the Board of Management against this apparently useless luxury, and as a consequence of the opposition of the paymasters, the drill-sergeant was superseded. Previous to his first engagement there had been great difficulty in the boys' dormitories. Mischief was constantly perpetrated in the night, bolstering and other amusements in the still hours were not uncommon, to the serious damage of the bed linen, night-dresses and other articles, in the dormitory. Coincidently with the introduction of the drill-master, this source of damage seemed to disappear. It revived soon after the dismissal of the drill-master, and then it struck the Chairman of the Board of Management that there was something more than a coincidence in this, that the two results had an alliance as cause and effect. The expense of repairs to bed furniture and night clothes was very much larger than the salary paid to the drill-sergeant. The cost of the one, upon close enquiry, was found to be more than three times the cost of the other. The Board determined to restore the drill-master as an experiment. By his return, quiet was obtained in the night to the occupants of the dormitories, and a serious loss to the managers prevented. The boys were properly tired out; even nightmare was comparatively uncommon under the new *regime*, sleep was sweet, and the boys no longer disturbed each other by horse-play at the wrong time.

The neglect of exercise is more marked in girls' schools than in those which are provided for boys, whilst females suffer in adult life even more than men from a neglect of its requirements. The restraint upon their freedom of motion, both by custom and the improper character of their dress, tends to increase the mischief; girls should exercise themselves quite as much as boys until they reach the age of twelve or thirteen, and there is no reason whatever why they should not be as active in their movements, and as energetic in their play as boys should be. Cricket, fives, rounder, and even leaping and swimming should be encouraged. Their dress should allow of this freedom of action, and prudish notions of such conduct being unfeminine should be put aside as contrary to health. When girls become young women,

and natural changes are taking place in their constitution, it may be time to change the form of exercise to something a little less boisterous; but rapidity of muscular movement, which rapidity should at times apply to all the muscles of the body, should be encouraged in girls at all ages. The use of the skipping-rope for boys, as well as girls, is to be encouraged, because it exercises all muscles equally, and does away with the tendency which is always present to take to one set of muscles more than another, and to throw the machine out of balance by developing the right side more than the left, or *vice versa*. I am in the habit of recommending parents when they find certain kinds of deformities to be threatening, to encourage their children to trundle a hoop with the left hand, the right being tied behind the patient; or to play at shuttlecock and battledore with the left hand, the right being similarly treated. This would be a very good kind of exercise to encourage in all schools, so that each set of muscles may be equally developed, and young children taught to use the left hand as much as the right.

Time allotted to Study.

The teacher should always bear in mind that long-continued occupation in any one direction is not good education, that excess of mental application is injurious to bodily strength, and that intemperance may refer to mental work, to bodily exercise, and the digestive functions, as well as to excess of liquor. The listless and reluctant attention which is met with in some schools is the opposite to that which holds good in those which are properly managed. Instruction must be adapted to the child's power; the talk must be made pleasant to the pulpil if it is to be rapidly understood. It is a great mistake to suppose that many hours per day must be devoted to study. Little children may be taught best by playing with them and by instructing them in their play and by their play. They learn much more efficiently than by compelling their attention in the solemn way which is followed in some dame schools, and even in schools for older children. To sit on a form and be quiet is necessary sometimes to enable the teacher to bring his class into proper subjection, but to make it the custom of the school is wrong. Sedentary occupation is altogether out of the question for little children; half an hour at one time is ample for them to be compelled to devote their attention to any one subject. There should be a relaxation for a short time every now and then for absolute play: a time for the muscles to follow their natural tendencies. For very young children even fifteen minutes is a sufficient length of time for close attention to one subject. Two to three hours a day at irregular intervals of corresponding length is ample time for mental work for children under eight years of age. It is probable that fully developed brains cannot stand more than nine hours' continuous mental labour for any length of time, without paying for it sooner or later. The gradations from three hours to nine may be gradually brought about by an increase of about a third of an hour a day for each year. Let any one calculate the amount of attention which can be given to a sermon or lecture, without the supervention of 'ennui,' and which marks the weariness of the listener, and if the subject is not very interesting he will be able to calculate the damage which school life does to brain development when irksome work is made more irksome by being too long continued. The Kindergarten system is an admirable one for young children, provided it is not kept up by excitement. I fear that sometimes the teacher errs on this side, and by trying to excite the attention of the little child, he, or rather she, overestimates the power of the little brain by introducing exciting topics and figures in a way which provokes attention; this kind of teaching is wrong. Ingenuity and vivacity on the teacher's part are necessary, but excitement is to be deprecated. For children over four years of age, and under seven, an hour or two in a Kindergarten school with frequent and short intervals, during which the will of the child should be master, will be the best discipline. No set lessons should be permitted until the age of seven or eight years. I am of opinion that the teaching of our veteran hygienist, Edwin Chadwick, is right teaching, and that the so-called half-time system among older children will bring about a far healthier and complete population than that kind of education in which the whole time is given to study. It is found by experience that children who attend school only three hours a day frequently make as good progress as those who are in the school-house for six hours; the mental work, if continuous, is as much as is good for the child, whilst it gives evidence of real progress. I like the plan of emptying a school-room every half hour, and allowing ten minutes for healthy exercise out of doors, which should take the form of leaping, running, or some other active movement of a vigorous and spontaneous character; if this is not possible by reason of the state of the weather, then a kind of drill should be practised, either in the schoolroom, or, better still, in some covered way, or in some other room, so that opportunity may be given for a purification of the vacated room by a thorough ventilation. I like the plan also which is adopted in some schools of regular drill at irregular intervals whilst at work at the desk. On a given signal from the teacher, say a particular kind of bell sounding, all the boys start to their feet at 'attention,' and perform a few muscular movements in rapid and regular succession. This change promotes a perfect circulation in the blood; it takes away from the muscular system a tendency to improper contraction, that which gives rise to annoying habits which many people get of beating time, in a way, which is sometimes called 'the devil's tattoo,' or having other 'peculiarities,' indicating a deformity of nerve force. The custom of drill is also advantageous as teaching children to be in subjection in a proper manner, and without injury to any part of the system. It also prevents them from becoming so absorbed in their work, by which they forget other duties altogether and become what is called absent-minded, to their serious detriment in after life.

School Desks and Seats.

Bad position in writing, drawing, and standing in class, or sitting upon a simple form, are very prominent causes of deformity. Twisted spinal columns, malformations in chest, stooping habits and shuffling gaits, with many kinds of bodily ailments, follow a want of knowledge by the teacher upon these points. Not the least evil is the influence which indulgence in a wrong position has upon the eyesight. The bad construction of the seats and desks which are in ordinary use in all schools has been a fruitful source of evil. Even the indulgence in right-handed work leads to malformation of muscles. It is therefore much to be desired that children should

be encouraged to practise exercises of all kinds with the left hand as well as the right, and even to learn to write with the left hand in early life, certainly to draw lines and figures with both hands equally well; and to handle the bat, and throw the ball first with one hand and then the other. It will be conducive to excellence in the end by producing a perfectly-fashioned figure, and preventing the formation of irregularly-developed muscles. This applies to the small muscles as well as those of larger size, and in no case with so much effect as with the minute muscles which regulate the eyesight. The eyeball is swung in a kind of sling which is acted upon by six muscles. The custom in school life frequently appears to be to prevent the development of these muscles by saving them from exercise altogether. Children are allowed to bring the eye in close proximity to the paper or the book, to twist the spine so that one shoulder is brought down and the other elevated; the neck is so twisted that the axis of vision is perverted, and one eye being on a different level to the other, the set of muscles in use are not equally acted upon, so that one muscle gets to be stronger than the other. The axis of vision is irregular, and the child gets more and more SHORT-SIGHTED. The next error is that which so-called 'occulists' encourage: the child is made to wear spectacles, by which means the chance of cure is taken away. The eye is irretrievably damaged by this course. The proper means to be taken is to exercise the eyes by making the child use the muscles together, and in an equally continuous manner, by placing him at a small distance from a series of letters attached to a wall, and then causing him to step backwards a few inches at a time, and encouraging him to use the muscles by focussing the eyes so as to get those muscles to act in harmony, and to lengthen the distance at which vision is perfect. If all the short-sighted children in a school were treated in this way for twenty minutes at a time every day, it would be found that the spirit of emulation would bring the muscles to equal and regular action, and the use of spectacles rendered unnecessary; that is, if the improper positions commonly indulged in at the desk are prevented by the class teacher. Desks must not be of an equal height for all children, they must be capable of regulation, so that a boy five feet high need not be obliged to sit at the same level as one four feet two. The taller boy has to stoop, or the shorter boy has to raise his head too much. The desk must not be too near or too far from the seat, and a flat desk is a mistake. The desk should incline slightly towards the child. The feet should be supported by a foot-board, and there should be always a fairly curved back to the seat so as to prevent fatigue to the child, and its natural consequence, a curve of the spinal column in the direction not provided for by nature. The seat upon which the child sits should not be a flat surface, but somewhat saddle-shape. It is discomfort which leads to deformity. Every effort should be made to obviate this by meeting the difficulty, either by providing support, or by taking the child away from the desk at frequent intervals to exercising another set of muscles by another kind of action. Change of posture and variety of movement are the best remedies for those misshapen conditions which are fostered in badly-conducted schools. The effect of drill is easily seen in the soldier. There is no deformity to be seen in the ranks; that which is effected in the army could be much more easily achieved in the school play-ground if a little attention was daily given to this subject. I am not advocating luxurious habits in reading and writing; fatigue should follow upon all work, but when the fatigue comes it is best to change the character of the occupation, and not allow it to go on in the same groove for too long a period. If this change of occupation is carried out properly, the position of the child is not of so much moment, but it is best for him to sit erect when writing to keep the eyes in a parallel line with the surface of the desk. the shoulders at an equal height, and the elbows close to the side, and not resting upon the desk itself. Weakly and delicate children should have a support for the whole of the back. I shall refer to these points more at length in the next volume, when treating upon the surgical requirements of school-life, as these are matters completely connected with curative means as well as preventive measures.

Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

Joint Author of 'The Field Naturalist's Handbook.'

No. X.—THE TRICHOPTERA AND HYMENOPTERA.

THE *Trichoptera—i.e.*, 'hairy winged' insects, were until comparatively of late years supposed to form part of the *Neuroptera*, to which they certainly bear a close resemblance.

The wings are four in number, generally tolerably equal in size, and, as a rule, more or less profusely covered with hair; the second pair are folded beneath the upper when the insect is at rest. The mouth, in the perfect insect, is not developed, so that no nourishment can be taken, just as is the case with the common May-fly.

The *Trichoptera* include those insects which are popularly known as Caddis-flies, and which are so dear to anglers, both in the larval and perfect stages of their existence.

In their life-history, as well as in the general details of their structure, the caddis-flies bear a strong resemblance to the dragon-flies, passing the earlier portion of their life beneath the surface of the water. Unlike those insects, however, they construct for themselves habitations, or 'cases' in which to pass their larval existence, these differing in structure according to the

species of the insect, and the nature of its surroundings.

As a rule, these cases are more or less cylindrical, and are formed of all manner of substances, leaves, sand, small stones, sticks, etc., being amongst those usually employed. The grub is, however, by no means particular in its choice, and will make use of any suitable object which may fall in its way.

Two small hooks may be noticed at the extremity of the body, by the agency of which the larva is enabled to retain its position in the case.

Towards the middle of May these cases may be found in great abundance in any suitable pool, a single sweep with a net often bringing up several double handfuls. A few weeks later on the perfect insects appear, and may be found in plenty in the neighbourhood of water. Several British species are known, but lack of space prevents me from describing them, and forces me to proceed at once to the next order of insects, namely, the *Hymenoptera*, or 'membranous winged' insects.

This can by no means be considered as a happy title, answering equally well to almost any of the great groups of insects. There is, however, no difficulty in distinguishing a hymenopterous insect at first sight, the anterior and posterior wings being united when in use by a series of small hooks running along part of the upper edge of the lower wing, and fitting into a groove in the lower edge of the upper wing.

These hooks differ in form to a very considerable degree in the various families of the *Hymenoptera*, those from the wing of a wasp, for instance, being very distinct from those taken from a bee or ichneumon. So much is this the case, indeed, that an experienced entomologist can detect, by the examination of a single hook, to which family of the order its owner belonged.

The second pair of wings are always much smaller than the first, and are intersected by fewer veins. The head is furnished with a pair of horny jaws, and also with a fleshy tongue, lying between and protected by them. The abdomen of the female is provided with an ovipositor formed of several parts, modified in some groups into a poison-bearing sting. The pupa is invariably quiescent, as is also the larva, except in the case of the Saw-flies.

The *Hymenoptera* are usually divided into two chief sections, viz., the *Terebrantia*, or 'Borers,' and the *Aculeata*, or 'Sting-bearers.'

The first subdivision of the leading group includes the Saw-flies and Gall-flies, in which the base of the abdomen is attached to the thorax by the whole of its diameter, the larvæ feeding upon vegetable substances of various kinds, and being furnished with horny mandibles and a well-developed mouth.

The saw-flies bear the appropriate title of *Tenthredinidæ*, an appellation formed from a Greek word signifying to gnaw, or nibble. The wings of these insects are large, the nervures forming several distinct cells; the abdomen is not connected with the thorax by means of a footstalk, and is provided, in the female, with the curious apparatus from which the name 'Saw-fly' is derived.

This consists of a couple of flat horny plates, placed side by side on the under surface of the extremity of the abdomen. These two plates constitute the saws, one edge being set with elaborately formed teeth, while the other is strengthened by a thick horny plate. In fact, the structure of the instrument almost exactly resembles that of our own tenon saws.

These saws slide into grooves, and are so constructed that one is withdrawn while the other is thrust forward. By their agency, a resting-place is prepared for the eggs, a groove being cut in a leaf, or twig, an egg placed therein by the ovipositor, and fastened by a small drop of a glutinous fluid secreted by the insect.

The larvæ of the saw-flies differ from those of the groups of *Hymenoptera* in possessing limbs, and passing an active existence. At first sight they might easily be mistaken for the caterpillars of lepidopterous insects, the general structure being of very much the same nature. Their true character, however, may be easily ascertained by an examination of the claspers, or false legs, which are never more than ten in number in the larvæ of the *Lepidoptera*, while the grubs of saw-flies possess from twelve to sixteen of these members.

Perhaps the most abundant, and certainly the most destructive of our British saw-flies, the Turnip-fly or Nigger (*Athalia spinarum*), must not be passed by without a few words of notice.

This terrible pest to the agriculturist is, happily, rather capricious in its visits, being seldom common in the same district during two successive years. When it does make its appearance, however, the turnip-crop vanishes as though before a swarm of locusts, scarcely a plant being spared by the voracious grubs.

Another destructive saw-fly is that known as *Nematus grossulariæ*, the larva of which wreaks considerable havoc upon the foliage of gooseberry bushes.

The last of our British saw-flies which can be mentioned in these pages is one that by few except practical entomologists would be taken for a saw-fly at all, the form and colouring being so like those of a hornet, that the mistake is little to be wondered at.

This insect is scientifically known as *Sirex gigas*, and is usually tolerably plentiful in pine woods, upon the solid wood of which the larva feeds.

In this insect the saws are modified into a sharp and powerful boring implement, consisting of three portions, the two outer parts acting as sheaths to the inner, or actual piercing tool. This weapon attains to a considerable size, being, in an ordinary female *sirex*, little short of an inch in length.

We now come to a very remarkable group of *Hymenoptera*, namely, the *Cynipidæ*, or Gall-flies.

These insects, usually of very small dimensions, produce the excrescences upon various trees and plants which are generally known as Galls, and which form a habitation for the larva. These galls are caused as follows.

The female insect makes a small puncture in a leaf or twig, and deposits therein an egg, and a small drop of an irritant fluid. This acts in some strange manner upon the juices of the plant, causing a swelling to form, in the middle of which lies the egg. This in due time hatches, and the young grub finds itself provided both with food and dwelling.

It is a curious fact that the eggs, both of the saw-flies aud gall-flies, increase in size to a considerable extent before the larvæ are hatched.

A vast number of gall-flies are already known to science, and others are annually being discovered. There are, however, but few students of the group, the small size and obscure habits of the insects rendering the study of their habits a matter of the greatest difficulty.

As a general rule, one larva only inhabits each gall.

With some species, however, the gall is composed of a number of cells, each containing a separate grub.

One of the most familiar of all the galls is that popularly known as the 'Oak-apple,' and which is produced by the dull-coloured little *Cynips Kollari*. Scarcely an oak tree or bush but bears a quantity of these curious objects, which are often used by way of ornament in the construction of various fancy articles.

Some of the gall-flies are double-brooded, and present a very remarkable phenomenon, the two generations being to all appearance totally distinct from one another, and having until very lately been considered as representing separate species. Recent investigators, however, have found that, different as they appear, they are in reality only alternate broods of the same insect.

The *Ichneumonidæ* comprise a vast number of insects, whose life-history is of the most singularly interesting nature.

These creatures are parasitic upon other insects, the larvæ usually spending their existence within the body of their victim.

Therein an egg is deposited by the parent insect, the young larva almost immediately hatching, and commencing to prey upon the body of its involuntary host. Instinctively avoiding the vital organs, it continues to feed upon the fatty portions until it attains its full development, when its victim succumbs to its attacks, almost the whole of the interior having been eaten away.

In some cases, a single egg only is deposited in the body of the larva; in others, the parasites may be reckoned by the hundred. In one instance, over one thousand specimens of a small ichneumon-fly were bred from a single larva of the Wood Leopard Moth (*Zeuzera æsculi*).

So vast is the number of insects composing this group that we cannot do more than glance at the history of more than two or three species, the first of which shall be the little insect known as *Microgaster glomeratus*.

This ichneumon must be ranked in the category of our insect benefactors, preying, as it does, upon the larvæ of the well-known 'white' butterflies, which are so terribly destructive to the cabbage crops. In some districts, indeed, the larger and more destructive of these insects has been almost annihilated by its tiny foe, and scarcely a single specimen is now to be seen where the butterfly formerly existed in thousands.

When full-fed, the parasites leave the body of their victim, and construct small cocoons of yellow silk, in which to pass their pupal existence. These cocoons may be seen in great numbers upon the fences bordering any field of cabbage, and are usually considered by ignorant persons as the 'caterpillar's eggs,' and destroyed accordingly.

The only other ichneumons to which space, or rather, the want of it, permits us to allude, are the curious little *Pezomachi*, which are parasitic upon the eggs of various spiders. These insects are without wings, and so closely resemble ants that a close examination is required to identify them.

The next great group is known as the *Aculeata*, or Sting-bearers, and comprises several families, the first of which consists of the ants. These, although represented in this country by comparatively few species, abound in tropical lands to an almost incredible degree.

These insects may be divided into two groups, namely, the social and the solitary ants. Very few of the latter are found in this country, and the interest centres almost entirely upon the social species.

These ants, like the bees and wasps, apparently consist of three sexes, namely, the male, the female, and the worker. It has of late years been discovered, however, that two sexes only in reality exist, the workers being nothing more than undeveloped females. One great proof of this fact lies in the possession by the workers of stings, which, in all the *Aculeata*, are found in the female insects alone.

In these ants, the perfect male and female only are furnished with wings, the workers being unprovided with those organs. Even the perfect insects bear them for a short time only, making a single flight into the air, where they choose their mates, and snapping them off close to the body immediately upon descending to the earth.

It has been well remarked that, if the anthropoid apes approach most closely to man in bodily form, the ants, small and insignificant though they are, most nearly resemble him in point of intellect. And when we come to examine the wonderful details of their life-history, of the organisation and regularity found in every part of the nest, of the division of labour, each individual insect having its appointed work apportioned to it, and of the manifold ways in which these insects seem almost to imitate man himself, we cannot but wonder that creatures so small, possessed neither of speech nor, to all appearance, of reasoning powers, should yet be enabled to perform feats requiring such surprising intelligence.

Many human institutions are found reproduced amongst these wonderful insects. Standing armies are kept up, and divided into corps, battalions, regiments, and companies, all under the command of regular officers, just as is the case with our own troops. The warriors go through the most surprising evolutions with an order and regularity worthy of the most highly-drilled soldiers in existence. Slaves are captured from other nests, and perform the duties of domestic servants and nurses. Several species of ants even bury their dead, and in numberless other ways prove the advanced state of their intellectual powers.

Volumes might easily be filled with descriptions merely of the habits of these wonderful little creatures, and we cannot but regret that lack of space obliges us to proceed to the next division of the *Hymenoptera*, namely, the *Diploptera*, or insects whose lower wings are folded longitudinally when not in use. This group comprises the insects popularly known as Wasps.

As is the case with the ants, there are solitary and social species, the former consisting of perfect male and female insects only, while in the latter undeveloped females, or workers are found, and play a very important part in the economy of the hives. These workers, however, are possessed of wings.

Very few of the Solitary wasps inhabit Great Britain, chief among them, perhaps, being the curious *Odynerus melanocephalus*, which hollows out the dead twigs of rose trees, etc., and constructs therein a series of cells, in each of which it deposits an egg, and a small caterpillar or two by way of food to the future grub.

The British Social wasps, eight in number, all belong to the genus *Vespa*, and construct nests of great beauty from a paper-like substance, formed by masticating small fragments of wood. With some wasps these nests are built underground, or in a hollow tree, or

other suitable locality; others construct pensile habitations, usually from the branch of some tree or bush. To the first class belongs the common wasp, while the little known tree-wasp and Norwegian wasp are included in the latter group.

In the British Museum may be seen a very curious series of nests of the common wasp, built by insects in the possession of the late Mr. S. Stone.

The Bees are included in the *Anthophila*, or 'Flower-lovers,' a family sometimes known as the *Mellifera*, or 'Honey-bearers.' These insects may also be divided into two groups, the social and solitary, the workers being only found in the insects of the former division.

The life-history of the most familiar species, viz., the common Hive Bee, is too well-known to need any description in these pages, and we will therefore conclude this paper with a short account of one or two of our less understood bees.

The most familiar of the wild social bees are those which are commonly called Humble Bees. Some make their nests in holes in the ground, some upon the ground, and others in rocky crevices.

The first-mentioned is the most plentiful. It takes possession of the deserted burrow of a rat or field-mouse, enlarges it as required, and by degrees produces a numerous brood. The cells are not hexagonal, and formed into combs like those of the hive bee, but are oval, and heaped together without any attempt at arrangement. This is the case with all the humble bees.

The Carder Bee (*Bombus muscorum*) is remarkable for the curious manner in which the nest is constructed, the insect collecting moss, grass, etc., and carefully drawing them through her legs, in much the same manner as wool is carded. With the material thus prepared, she builds a kind of dome-like structure upon the ground, carefully covering it so as to resemble the surrounding earth. Within this are constructed a series of oval cells, placed at irregular intervals.

This is a very common species, and, if approached with care, may be examined while at work, and the structure of the nest inspected.

The Red-hipped, or Stone Humble-bee (*Bombus lapidarius*), is a very familiar species, and derives the second of its popular titles from the situation of its nest, which is generally placed beneath a heap of stones. Should such a position be unattainable, the nest is usually constructed in a hole in a bank, or other convenient locality.

In all, about eighteen or twenty species of humble-bees are found in Great Britain, many of this number however, being extremely scarce.

(To be continued.)

Anecdotal Natural History.

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No. XII.—THE RHINOCEROS, HYRAX, AND HIPPOPOTAMUS.

THE RHINOCEROS is connected with the elephant by a number of links, such as the Tapir, in which a small and imperfect proboscis is present, and the various swine, in which the proboscis is modified into a very mobile, blunt-tipped snout, with the nostrils at the extremity. Geology, too, has revealed traces of many animals which are now extinct upon the earth, and which render the transition between these animals very much less abrupt, conclusively proving their approximate position in the scale of creation.

The rhinoceros, of which several species are known, is found in various parts of the African and Asiatic continents, preferring those neighbourhoods in which water is easily to be obtained. Although the various species differ in several minor characteristics, they are sufficiently alike in their chief peculiarities of structure to allow of a single description sufficing for the whole.

The so-called 'horn' is naturally the first point to attract our attention; and a very curious and wonderful object it is.

Notwithstanding the powerful shocks it is called upon to bear, and its uses as a weapon of offence, it is not in any way connected with the skull, as is almost universally imagined to be the case. It is, in fact, merely a growth from the skin, from which it may be removed by a few cuts around the base from a keen-bladed knife. An ordinary pen-knife is quite sufficient for this purpose. This horn must be ranked in the same category with hair, spines, and quills, the structure being precisely similar in all. This may be at once proved by an examination of the horn, which, although smooth and polished at the tip, is separated at the base into a number of filaments, the hair-like formation of which may be easily seen.

In order to avoid the effect upon the brain of the violent concussion caused by the headlong charges of the animal, the bones of the face are modified in a very remarkable manner, forming a kind of broad and strong arch, one end of which is left free and unsupported. Above this end the horn is situated, the elasticity of the bony arch effectually breaking the force of the shocks. The horn does not attain its full dimensions for several years after the birth of the animal.

In olden times, the horn of the rhinoceros was held in great estimation on account of its supposed poison-detecting powers, and bore a fancy value in consequence. Eastern monarchs, for example, were accustomed to have their drinking-cups formed from the horn, the superstition being that any poison introduced into the vessel would cause the contents to bubble violently, and so bring about a discovery of the attempted assassination.

At the present time the horn is still of considerable value, being largely employed in the manufacture of umbrella handles and various other articles.

The skin of the rhinoceros is of great thickness, and of so tough a nature that it will resist any but a specially hardened bullet. The balls used in the chase of the animal are therefore alloyed with solder or tin or mercury, in order to supply the requisite hardness.

By the natives of both Africa and Asia the skin of the rhinoceros is greatly prized, being largely utilised in the manufacture of shields, which form a most effectual protection from spears, no matter how keen their points or how great the force with which they are hurled. Even a rifle bullet, indeed, unless fired at close quarters, would probably be checked or turned aside in its flight.

Yet, stout as is the skin in most parts of the body,

there are places where its character seems to be altogether changed. In the Asiatic species of rhinoceros, for instance, the skin falls in heavy folds upon the neck, shoulders, and flanks, forming flaps which may be lifted up with the hand. Beneath these folds the skin is of a much softer and more delicate nature, and may be pierced without any very great difficulty. This fact is taken advantage of by the various parasites which infest the tropical forests, and which insinuate themselves beneath these folds, directing their attacks upon the thinner skin lying beneath them, and driving the animals almost mad by their incessant persecutions. Upon the under side of the body, also, the skin is comparatively soft.

Here we find a reason for the fondness of the rhinoceros and its allies for wallowing in the mud, the thick tenacious substance rapidly hardening beneath the rays of the sun, and affording an impenetrable barrier to the tiny assailants.

The eyes of the rhinoceros are by no means large, and are placed rather deeply in the head, the sight consequently being of a rather imperfect nature; in fact, the animal is unable to see any object directly in its front. The senses of scent and hearing are, however, developed to a considerable extent, and fully compensate the animal for its partial lack of visual power.

The INDIAN RHINOCEROS (*Rhinoceros unicornis*) is chiefly remarkable for the comparatively small size of the horn, the height of which sometimes little exceeds the diameter. It nevertheless forms a most effectual weapon, a well-known traveller stating that this animal is able to hold its own against an adult male elephant.

Another of the Asiatic species is the Sumatran Rhinoceros, which is provided with two horns upon the head instead of one. It does not appear, however, to make use of its formidable weapons, for its disposition is very quiet and timid, the animal flying from the presence of danger, and seldom facing even a single dog.

FOUR distinct species of rhinoceros are at present known to inhabit Africa, and it is yet uncertain whether still others do not exist.

The best known of these is the Rhinaster, Borele, or Little Black Rhinoceros of Southern Africa (*Rhinoceros bicornis*), which may be known by the shape of the horns and the upper lip.

The anterior horn is long, pointed, and curved backwards towards the head, while the posterior one is small and conical, closely resembling the weapon of the Indian rhinoceros. The upper lip, which is sharply pointed, overlaps the lower to a considerable extent.

The Borele is usually considered to be by far the most savage of all the species of rhinoceros, and the natives are said to fear the animal far more than they do the most infuriated lion. When wounded it is a truly dangerous opponent, and will attack its foe with a ferocity and determination which render escape a matter of considerable difficulty.

During the day-time the animal is seldom to be seen, selecting some secluded retreat in the thickest part of the forest, and there passing the hours of daylight. When night sets in, however, he awakes, and at once sets out for the nearest pool in order to slake his thirst before prosecuting his search for food.

This he generally finds in various roots, which he ploughs out of the ground by means of the powerful horns, and also in the young shoots of the 'wait-a-bit' thorn. Clumsy as it is in appearance, this rhinoceros is yet active and agile to a wonderful degree, possessing considerable speed, and severely trying the powers even of a good horse when attempting to escape from its furious onslaught.

Another well-known African species is the Keitloa or Sloan's Rhinoceros (*Rhinoceros keitloa*), which may be readily distinguished from the borele by its horns, which are of considerable and almost equal length. It is altogether a larger animal than the preceding, and is, if anything, even more to be dreaded as a foe, owing to its superior strength and length of horn.

Both the borele and the keitloa are black in colour; there are, however, two African species of rhinoceros in which the colour of the skin is a greyish white.

The first and more abundant of these is the common White Rhinoceros, or Muchuco, as it is termed by the natives (*Rhinoceros simus*), which differs considerably in appearance from the two above-described species. Setting upon one side the colour of the skin, the chief differences may be summed up as follows. The muzzle is square instead of pointed, the head is elongated, and the anterior horn attains to considerable dimensions, three feet being by no means an uncommon length. The second horn, however, is of far lesser size, and closely resembles that of the borele.

In disposition, also, the animal is very different, being as mild and peaceable as the borele and the keitloa are fierce and savage. Even when attacked it seldom assumes the offensive, but generally seeks safety in flight instead of endeavouring to revenge itself upon its pursuer. Should its young be assailed, however, it will fight with great fury, and is then to the full as dangerous an opponent as either of its relatives.

The second of the white species, viz., the Kobaoba, or Long-horned White Rhinoceros (*Rhinoceros Oswellii*), is a very much rarer animal, and is far less generally distributed.

The anterior horn of the kobaoba is of considerable size, sometimes exceeding four feet in length. Owing to the manner in which the head is carried, this horn, which is almost straight, and is directed forward instead of backward, is generally found to be more or less worn away by the friction with the ground. In consequence of its length and straightness the horn is of great value in the market.

A walking-stick made of a single piece of this horn will fetch almost any price in London or Paris. In the old days of muzzle-loading rifles, a ramrod made of rhinoceros horn was invaluable, as it was almost unbreakable, and yet was tolerably light to carry. A large knob was left at one end, and so it became not only a loading rod, but a formidable weapon. Short clubs of similar form are much used by the Kaffir tribes in hunting, and are called knob-kerries.

All the African species of rhinoceros are occasionally to be seen in small herds of eight or ten specimens, but can yet be scarcely described as gregarious, each animal in time of danger separating from his companions and selecting his own path. They are not prolific animals, a single young one only being produced at a birth.

THE HYRAX.

We are told in Ps. civ. *v.* 18, that 'the rocks are a refuge for the conies,' and in Prov. xxx. *v.* 26,

reference is made to the same animal. 'The conies are but a feeble folk, yet make they their houses in the rocks.' The 'coney' is also named in the book of Leviticus as one of the animals which might not be eaten by the Jews.

Now, the coney which is here mentioned is not the rabbit, as most readers of the Scriptures suppose.

Rabbits are not frequenters of rocks. They live in holes which they excavate with their fore-feet, so that they need a tolerably loose soil, and would be entirely at a loss among hard rocks. The animal in question is a little creature, so like a rabbit in general appearance that it might well be mistaken for that animal.

Its teeth are apparently those of a rodent, and its feet look very much like those of the rabbit. It is clothed with brown fur, very much like that of the wild rabbit, and it is wonderfully active, darting about with such rapidity that the eye can scarcely follow its movements.

But, when examined by the eye of the zoologist, the rodent-like teeth are those of a miniature hippopotamus, and the paw-like feet are seen to be composed of hoof-clad toes like those of the rhinoceros. The rhinoceros has three toes on each foot, while the hippopotamus has four. The Hyrax has four toes on the fore-feet, and three on the hind feet. In fact, this little creature, so apparently dissimilar to the hippopotamus and rhinoceros, forms a connecting link between them.

The species of Hyrax which inhabits Africa is popularly called the Rock-rabbit by the English colonists, and Klip-das by the Dutch. Its scientific name is *Hyrax Capensis*, that of the animal mentioned in Scripture being *Hyrax Syriacus*. It is called 'Ashkoko' by the natives.

Both creatures have similar habits. They are exceedingly wary, darting into the recesses of the rock at the slightest alarm, or, if they fear that their movements may betray them, crouching motionless against the rock and resembling it so closely that the keenest eye can hardly detect them.

THE HIPPOPOTAMUS.

Having now traced the connection between the elephant and the swine through the tapir, and that between the rhinoceros and Hippopotamus through the hyrax, we come to the Hippopotamus itself.

This animal (*Hippopotamus amphibius*), often known as the River-Horse, or Sea-Cow, is a native of various parts of Africa, being never found very far from the neighbourhood of water. Huge as is the animal, its size lies chiefly in the bulk of the body, the legs being very short, and the actual height seldom exceeding five feet.

The teeth of the hippopotamus are of wonderful size and curious shape, the canines being strongly curved, while the incisors lie almost horizontally. These latter are chiefly used in tearing up the various aquatic plants upon which the animal feeds. These teeth are of very fine quality and close consistency, and, the ivory obtained from them retaining its colour for a great length of time, are of considerable value, averaging in price from £1 to £1 5s. per lb. A single tooth is usually from five to eight pounds in weight.

Formidable as these teeth appear, they are employed solely for the purpose of feeding, unless the animal is wounded, or otherwise irritated. For their legitimate purpose they are most suitable implements, capable of severing a stem of considerable size, or of cropping the herbage as closely as if a scythe had been employed.

In consequence of its huge appetite and destructive habits, the hippopotamus is an object of great detestation in the neighbourhood which it frequents, as its constant visits to the plantations in the vicinity result in an almost total destruction of the crops. And the havoc it causes is all the greater on account of the position of its legs, which, being very short, and set widely apart from one another, oblige the animal to make two distinct tracks, thus exactly doubling the damage caused by its passage through the crops.

In order to check its ravages as much as possible, various means are employed, chief among them being the pit-fall and the 'down-fall.'

The first of these needs no explanation, and the latter may be described in a few words.

A log of wood is heavily weighted at one end, and furnished with a spear-head dipped in poison. This is suspended to a branch over the path of the animal. To this is fastened a cord, which is carried across the track in such a manner that the pressure caused by the advancing hippopotamus causes the log to fall, and the poisoned spear to sink deeply into its body. The doom of the animal is then effectually sealed, the venom performing its destructive work in the course of a very short time.

The hippopotamus is also slain by means of a specially-constructed harpoon, consisting of a stout shaft, some ten or twelve feet in length, and a barbed point fitting loosely into a socket at the end of the shaft, to which it is fastened by means of a rope composed of a number of separate strands—this is in order to prevent the animal from biting it asunder. To the handle is fastened a stout line, to the other end of which a float is attached.

When an attack upon one of these creatures is contemplated, the hunters proceed, by means of a raft, into the midst of a herd, and plunge the harpoon into the body of the nearest animal. The wounded hippopotamus immediately dives, but is unable to shake off the harpoon, owing to the barbed point. As often as he rises he is attacked with spears, etc., which speedily complete the work of destruction.

Sometimes the wounded animal turns savagely upon its pursuers, and succeeds in tearing the raft or boat to fragments, occasionally killing one or more of the crew before they are able to reach the land.

The hippopotamus is generally found in tolerably large herds, each consisting of from twenty to thirty or more animals. Chiefly aquatic in their habits, they are generally to be found in the larger rivers and lakes. They are not averse to salt water, being often noticed floating or swimming in the sea itself.

The hide is enormously thick and strong, being fully two inches in thickness along the back. The well-known 'sjambok' whips are formed from this skin, which is prepared for use in a somewhat curious manner. Strips of suitable length are cut, and are then beaten with a hammer in order to consolidate the substance of the hide. This done, they are thoroughly dried, and are finally rounded off and polished by means of a sharp knife and sandpaper.

A well-made sjambok is a terrible weapon, capable of cutting a deep groove in a deal board with a single well-directed stroke.

There are two kinds of sjambok. One is used for driving oxen, and is attached to a long bamboo handle in such a manner that the complete instrument looks like a gigantic fishing-rod. In the hands of an experienced driver it becomes a terrible weapon, to which even the tough hide and obstinately sluggish nature of the African draught ox are forced to succumb.

The driver can direct his blow with unerring certainty, and a single stroke will cut completely into the skins of two oxen at once, raising a cloud of hair, and often causing blood to spirt from the wound. The crack of this sjambok is as loud as a pistol shot, and at the very sound of it the oxen fling themselves against the yokes so as to avert the dreaded blow.

The short sjambok is popularly known as the 'cowhide,' because it is made of the hide of the 'sea-cow.'

In order to retain the vital heat below the surface of the water, a similar provision is found in the hippopotamus to that with which the whale is furnished. Beneath the skin is a thick layer of fat, a wonderful non-conductor of heat, while a system of glands keep the outer skin constantly lubricated with oil, and thus prevent it from coming into actual contact with the watery element.

The sub-cutaneous fat-layer is considered a great delicacy, and is known by the Dutch colonists as 'Zee-koe speck,' or sea-cow bacon.

The animal possesses the remarkable power of sinking the whole of its body beneath the surface at will, and remaining under water for a considerable period of time. It is probable that this feat is accomplished by some contraction of the body, so that, while the weight remains the same, the bulk is considerably decreased, and a lesser quantity of water displaced.

Like the rhinoceros, the hippopotamus, whether upon land or in the water, is usually a very sluggish animal, and seems greatly averse to active exertion. When attacked, however, or otherwise alarmed, it exhibits the most wonderful activity, dashing through the water in a series of tremendous leaps, or rushing through the forest with the most unexpected rapidity. Few obstacles can stand against the onset of an infuriated hippopotamus, the great bulk of the animal bearing down almost any barrier that can be opposed to it.

The colour of the hippopotamus is a dark brown, marked with a number of irregular lines resembling the cracks on the surfaces of old oil paintings. The skin is marked with a number of sooty black blotches, which are only visible, however, upon a close examination. When the animal is living, the ears, nostrils, and the ridge over the protruding eyes are of a bright red colour, and form capital marks for the rifle of the hunter.

The slaughter of the hippopotamus by means of the rifle is not at all an easy process, as the animal, when alarmed, sinks at once to the bottom, and only occasionally rises to the surface for air. Even on these few occasions the nostrils alone are exposed above the surface, so that only a very well-directed bullet can do any harm.

The hunter always endeavours to lodge his first ball in the nostrils, as, if they be wounded, the animal is unable to remain submerged. A second bullet in the eye, or behind the shoulder, will then mostly complete the business.

When in her native rivers, the female hippopotamus is a model parent to her offspring, carrying her cub about on her back, and tending it with the most affectionate care and solicitude. In confinement, however, she generally behaves differently, and has on more than one occasion been known to kill her infant in a fit of passion.

In former days the hippopotamus was a native of Europe, and the fossil remains are found even in our own country, the London clay being especially productive in these relics of a bygone time.

(To be continued.)

'How I Teach Elementary Science.'

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Head Master of the Gloucester Road Board School, London.

FOURTH-SCHEDULE SUBJECTS: 'MECHANICS.'

IN the lesson on 'Matter in motion' I endeavoured to lead the boys to the conclusion that every object we see around us is 'on the move'; that every particle of matter is in motion; in fact, that 'motion is the law of the universe.' At the close of my remarks, a boy asked the question—'What makes everything move?' Another boy seemed especially anxious to know why the little specks he could see in the sunshine were all in motion. Although in the next lesson—viz., the one on 'Force'—I had intended to proceed to the consideration of the various forces in nature from a different startpoint from that suggested by the boys' questions, I at once decided that it would be preferable to take those questions and let them form the basis upon which to build up in the children's minds all the conceptions I wish them to have concerning 'force.' It is not an easy matter to get boys to grasp clearly the true nature of force. Of course it *is* a very easy matter to make the boys learn verbal definitions of the various forces; and some teachers may be content to do thus much; but no true educator will. In the present article I do not intend to re-produce a lesson, but rather to indicate how I treat this portion of the subject. In the first place, it is necessary that I should myself have clear and correct conceptions of the nature of force, and then that I should decide upon the best way of evolving such conceptions from the ideas already in the minds of the boys. Let me therefore state first what I understand the scientists of the day to mean when they talk of 'force.' We become cognizant that the matter of the universe, of which we form a part, manifests under certain circumstances distinct properties, qualities, or 'affections.' Of these affections of matter, we may enumerate—attraction, heat, light, motion, electricity, magnetism, etc. Some of these, and probably all of them, may be resolved into one, viz., 'motion.' That is to say, magnetism, for instance, is a motion of the atoms of the body said to be magnetised. So is electricity. The two motions different. One, for example, may be motion in an angular manner; the other straight. Again, light and heat are modes of motion of the atoms of matter. In infinitesimally short distances. Inconceivably rapid. In other words, that these affections are not in themselves 'entities.' Not things having an existence of themselves. When, for instance, I put a poker in the fire and it gets hot, it is

not that something called 'heat' has passed from the fire and gone into the poker, but that the atoms of iron, etc., which make up the matter of the poker have been put into motion. It is this motion we become conscious of and call 'heat.' When any of these affections re-act upon matter, the re-action is termed 'force.' For example, when the sun's heat re-acts upon the carbon dioxide (carbonic acid) that has entered the leaf of a plant by the stomata, and also upon the mass of green cellular matter, in the midst of which the gas is introduced, the heat force is sufficient to break up the CO_2, to fix the carbon in the leaf, and liberate the oxygen. We therefore speak of 'heat force,' magnetic force,' 'force of gravitation,' and so on. Probably what we term 'muscular force,' is but a modification of heat force. Any one force having operated, is not thereby annihilated; it re-appears either as the same, or as some other force. I have said that these affections of matter may be resolved into one—motion—and so force is said to produce motion. Practically this is sufficient. It is, however, quite clear that force is but a 'subtle mental conception.' We do not see force, we only know or see its effect—motion. The next question is, how much of all this shall I place before youthful minds. This will, of course, depend upon the capacity of those minds. I feel that it would be quite impossible for any fifth and sixth standard boys to grasp all that I have here stated. What shall I do then? Shall I tell them that force is something else, easier to explain? Certainly not. I will say what is true, or say nothing. A short time since, one of my assistants was giving a lesson on the expansion of metals by heat. This was his explanation. 'There is something' said he, 'called heat or caloric, that enters into the body of the metal.' He then went on to explain that this something gets between the atoms of the metal, takes up room, and pushes those atoms farther apart. Therefore the mass of metal must occupy a larger space. If more heat be introduced, the atoms go farther apart and the solid becomes a liquid; if still more heat be applied, the atoms are pushed apart altogether, and the liquid becomes a vapour. Now this statement was clear enough to the boys—that is, they easily understood what the teacher meant. A conception *had* certainly been formed in their minds. But was it true? Calling the teacher on one side, I asked him if he had read Tyndall on heat. He said he had. 'Then,' I remarked, 'that is not the way *he* treats of heat.' The teacher admitted it was not, but that he felt it impossible to get the boys to grasp Tyndall's notion of heat, and so had adopted an easier method of explanation. 'But,' said I, 'you have told the boys something that when they grow up and read, they will have to *unlearn*, because false. Now this morning in the Scripture lesson you said it was good to honour parents; is it not possible that when they discover your statement about heat to be false, they will entertain a doubt respecting the "honour due to parents"?' And so with regard to 'force;' I cannot expect the boys to grasp the entire subject; I must therefore submit a few elementary ideas, which shall, however, be correct as far as they go; so that in after life the boys, if so minded, may safely build up upon the foundation I have given them, but not find themselves compelled to sweep away that foundation entirely, and lay one more solid and genuine.

The following is my 'method' in giving a lesson on 'force.' Call one or two boys out, and get them to move various objects about—*i.e.*, push the inkstand along on the table, carry a chair from one part of the room to another, and so on. Lead them to see the necessity of having a word to denote the exertion they have each put forth. So get the word 'force.' Write on the board 'force produces motion.' Note the raindrops or flakes of snow in motion, explain the force that produces or gives rise to this motion—viz., the force of gravitation, or the force of the wind which is the result of heat force, and of gravitation. So by many examples lead up to the conception that all motion necessarily implies the operation of some force. Note some of the forces in nature. Then gradually conduct the class to the definition:—Force is that which produces or tends to produce motion, or that changes or modifies motion. If time will allow, definitions may be given of the 'force of gravitation,' 'chemical force,' 'electric and magnetic force,' and, if a lesson has already been given on 'heat,' then a definition of 'heat force.' It is pleasing to see how soon the boys get to connect the idea of force with that of motion. Force causes the mountain stream to flow, brings down the water of the cataract, acts upon the weights of the clock and sets wheels and hands moving, and drives all machinery.

In next month's article I will reproduce the lesson upon the relations of 'force,' 'energy,' 'work,' etc.

Education Department.

Syllabus for Male Candidates.

DECEMBER, 1882.

The Examination for Certificates will commence on Monday, the 11th of December, 1882, at 3 p.m.

1. This Syllabus shows the extent of the examination, but Acting Teachers may obtain Certificates who can *read and *write well, and answer simple questions confined to the following subjects:—

(1) English History (leading facts).
(2) Geography (elements of, and British).
(3) *Arithmetic (including proportion, practice, vulgar and decimal fractions).
(4) *English Composition, Spelling, and Parsing.
(5) *School Management, including in all cases questions under Section 2 of the second year's paper on this subject.
(6) Geometry, in the case of Candidates for a certificate qualifying them to be entrusted with the charge of Pupil Teachers.

2. Failure in any of the subjects marked with an asterisk excludes a Candidate from a certificate.

3. Acting Teachers attending the examination may, at their option, take the papers of the first or second year. The questions set will be such as can be answered from text books in common use.

4. The relative proficiency of the candidates according to examination, and whether they were examined in papers of the first or second year, is recorded in their certificates.

Reading and Repetition from Memory.

First Year.

To read with a distinct utterance, due attention to the punctuation, and just expression. Each *Student* must have learned at least 300 consecutive lines of poetry from the work selected under Grammar (section 2), and will be called upon to repeat some part at the Annual Inspection of the Training College.

Second Year.

Candidates will be expected to show improvement in the higher qualities of reading, such as expression, modulation of

* The Students of the *first* year will be expected to read a passage from Goldsmith's *Traveller and Deserted Village*, Milton's *Comus*, and Lamb's *Tales from Shakespeare*; the Students of the *second* year from Shakespeare's *Richard II.* and *Tempest*, and from a newspaper. These authors must not be studied in class, but must be left to the private reading of the Students.

voice, and the correct delivery of long or involved sentences. Each *Student* must have learned at least 300 consecutive lines of poetry, or 200 consecutive lines of prose from one of the works named under Grammar, and will be called upon to repeat some part at the Annual Inspection of the Training College.

Penmanship.

First Year.

1. To write a specimen of the penmanship used in setting copies of text hand and small hand,
2. To write a passage from Dictation.
3. The general character of the writing in the Examination Papers will be considered in deciding upon the proficiency of Candidates in the subject.

Second Year.

As in First Year, but defects more severely visited with loss of marks.

NOTE.—Writing, as taught in schools, is apt to be too small and indistinct. Pupils should be taught to write a firm, round, legible hand.

School Management.*

First Year.

1. The methods and principles of elementary teaching, generally, and with special reference to the development of the intelligence of children.
2. Notes of Lessons.
3. The form of school registers, [the mode of keeping them, and of making returns from them.

Second Year.†

1. To teach a class in the presence of Her Majesty's Inspector.‡
2. To answer questions on the following subjects :—
(*a*) The different methods of organising an elementary school.
(*b*) The form of school registers, the mode of keeping them, and of making returns from them.
(*c*) The ventilation and drainage of school premises.
3. The training of the senses and of the memory ; the processes of reasoning ; the order in which the faculties of children are developed ; the formation of habits and of character ;—all considered in their application to the methods of teaching and of moral discipline.

Grammar and Composition.

First Year

1. The elements of Grammar.
2. To parse words selected from passages in Byron's *Childe Harold's Pilgrimage*, Canto IV., Stanzas 1–48, and 140–end.
3. To analyse passages from the book selected.
4. To write plain prose upon a given subject.
5. An explanation of the meaning and words in the selected passages.

Second Year.

1. To paraphrase passages from Shakspeare's *Macbeth*, and Bacon's *Essays* (1–26).
2. To answer questions on the language, style, and subject-matter of the work chosen for paraphrase.
3. To write plain prose upon a given subject.

Geography.

First Year.

1. The elements of Geography, Mathematical and Physical.
2. To describe in words, and draw the map of, the four quarters of the globe, of each country in Europe (that of Great Britain in fuller detail), and of Hindostan, Australia, New Zealand, Canada, and the South African colonies.
3. The Political Geography of the British Empire.

* Passages taken from Reading Lesson Books commonly used in schools may be given in the papers on all subjects which admit of it, and candidates will be expected to show how they would explain such passages to children. Each paper may also contain questions on *the method of teaching* the elementary parts of the subject to which it relates.

† No student will be examined, unless the Principal certifies that he has spent at least six weeks, or 150 hours, in the Practising and Model Schools, under proper superintendence, during his residence, and at least half that time during his second year.

‡ Students to be examined under Article 105 must also teach a class in the presence of Her Majesty's Inspector.

Second Year.

1. The Geography—Physical, Political, and Commercial—of the British Empire.
2. Map drawing, confined within these limits.

History.

(The papers will contain questions on the history of Scotland.)

First Year.

General outlines of British History.

Second Year.

A special period in greater detail. From the year 1715 to the accession of Queen Victoria.

Arithmetic, Algebra, and Mensuration.

First Year.

1. To work Arithmetical sums, both mentally and on paper.
2. To prove and explain the rules.
The figures should be well formed and the work methodically arranged as a good model for children to imitate.
3. To answer simple* questions, both theoretical and practical, in Algebra, and the Mensuration of plane surfaces.

Second Year.

More difficult questions,* and problems, in Algebra and Mensuration.

Geometry.

First Year.

The first two books of Euclid, with simple deductions from the propositions.

Second Year.

The first four books of Euclid, and the first *fifteen* propositions of the Sixth Book, with simple deductions from the propositions.

Economy.

Second Year.

Elementary Questions in Political Economy. Works on this subject, published of late years for use in schools, contain matter to which these questions will have reference.

Vocal Music.

First Year.

1. Notation: the treble and bass staves, and the relation between them.
2. Time : Simple common, and simple triple.
3. The scales, major and minor ; with the intervals (major and minor, perfect or other) found in both, and the chromatic intervals found in the latter.
4. Transposition from one key to another ; and transcription from one variety of time to another (as from $\frac{3}{4}$ to $\frac{6}{8}$).

Second Year.

1. Notation : The alto and tenor staves, and their relations to the treble and bass.
2. Time : Compound common, and compound triple.
3. Classification of intervals, as perfect and imperfect, consonant and dissonant.
4. Resolution of individual dissonant intervals.
5. Rudiments of harmony : Positions of chords ; progression ; inversion ; discords by suspension (on fundamental basses only); the discord of the dominant seventh (in its direct form only).

* In *Algebra*, the Students of the first year should understand the four simple rules, involution, evolution, common measures, common multiples, algebraic fractions and surds, ratios and proportions, progressions, and the solution of simple and easy quadratic equations, of one or more unknown quantities, or problems producing such. Those of the second year should, at least, add to this a knowledge of permutations and combinations, the Binomial Theorem, logarithms, interest and annuities, scales of notation, and the solution of more difficult equations or problems producing such.

In *Mensuration*, the Students of the first year should understand the measurement of every species of plane rectilineal figure. Those of the second year should add to this a knowledge of the measurement of circles or parts of a circle, cylinders, spheres, cones, and a few irregular solids.

Students of the first year who do not obtain at least 60 per cent. of the total number of marks obtainable in Algebra and Mensuration will be required to take up the same portions of those subjects in their second year.

NOTE.—A *paper* on this subject is not given to any Student, about to leave the Training College, who has not passed the Musical Inspector's examination in practical skill. Acting teachers who take this paper must produce a certificate from some competent person (such as the organist of their church) that they have '*such an 'amount of musical skill, vocal or instrumental, as 'is sufficient for the purpose of teaching children to sing 'from notes.*'

Drawing.

[*N.B.*—This exercise does *not* form part of the *December* examination. Annual examinations, *in drawing only*, are held at each of the *Training Colleges* under inspection some time in November, and at the various *local drawing schools* in connection with the Department of Science and Art, at times to be learned from the masters of those schools. The value of the exercises is marked, and the marks carried to each candidate's total, for a certificate under this Syllabus.]

The series of exercises prescribed in the Art Directory* of the Department of Science and Art for a drawing Certificate of the Second Grade.

Special Subjects.

Additional marks will be given to a Candidate for success in some of the following subjects, provided that he passes for a Certificate, according to this Syllabus, without counting marks for these special subjects.

I. Languages.

1. Latin.
2. Greek.
3. French.
4. German.

Candidates may take one or two (but not more) of these languages. *Students* will be examined in those languages only for which a special course of instruction is provided in the Time Table of their College.

First Year.

This paper will contain grammatical questions, and easy passages† in prose for translation from and into English.

Second Year.

This paper will contain harder passages† (in poetry as well as prose) for translation from and into English prose, with questions upon the construction of particular sentences.

II. Science.

See Extracts from Minute of 17th January, 1878.
At Whitehall, the 17th day of January, 1878.

BY THE RIGHT HONOURABLE THE LORDS OF THE COMMITTEE OF HER MAJESTY'S MOST HONOURABLE PRIVY COUNCIL ON EDUCATION.

1. The Lords of the Committee of Council on Education consider the subject of Science Instruction in Training Colleges. They believe that the time has arrived when a special examination should be instituted at a period of the year better adapted to the Training Colleges than May; and that the nature of the examination and the payments made on the results should be modified to suit the circumstances of those Colleges.

2. They therefore determine that in future a special examination in Science shall be held in Training Colleges in December, immediately before the ordinary Christmas Examination.

3. *The examination will not be open to Acting Teachers.* It will be held in those subjects only for which a special course of instruction is provided in the time table of the College, and will be conducted by one of Her Majesty's Inspectors, or by an officer of the Science and Art Department.

4. No Student in a Training College will be allowed to attend the May examinations of the Science and Art Department.

5. The examination will be confined to the following ten subjects :—

1. Mathematics.
2. Theoretical Mechanics.
3. Applied Mechanics.
4. Acoustics, Light and Heat.
5. Magnetism and Electricity.
6. Inorganic Chemistry, including practical Chemistry.
7. Animal Physiology.
8. Elementary Botany.
9. Physiography.
10. Principles of Agriculture.

6. No Student will be permitted to take up more than *two* subjects in any one year. Women will not be permitted to take more than one subject in a year.

7. The examination, except for Mathematics, will be based on the syllabus of the several subjects given in the Science Directory. But the two stages, Elementary and Advanced, will be treated as a whole—one paper only being set. These examination papers will be framed much as the present May papers are framed, that is to say, with a certain number of compulsory questions, and a certain number of optional questions, some of the latter being more difficult, and more highly marked, than the rest. Questions will also be set on the method of teaching various branches of the subject. The syllabus for the Mathematical examination is given in the Appendix.

8. The successful Students will be placed in the 1st or 2nd Class, the Standard for a 2nd Class being as high as that of a *good* 2nd Class in the present Advanced Stage, and for the 1st Class of a *good* 1st Class in the Advanced Stage.

9. All Students who pass will be registered as qualified to earn payments on results and will receive certificates, but no prizes will be given.

APPENDIX.

SYLLABUS FOR MATHEMATICS IN TRAINING COLLEGES.

Geometry—

All the propositions of plane geometry; including the doctrine of proportion, so far as it is treated in the definitions of the fifth and in the sixth book of Euclid.

Algebra—

Up to indeterminate coefficients and continued fractions.

Logarithms—

Trigonometry—

So far as it is required for the measurement of triangles, areas, heights, and distances.

Solid Geometry—

First principles, including the volume and surface of the right cylinder, cone, and sphere.

A student who passes in this subject will be registered as qualified to earn payments on results in Stages 1, 2, 3, and 4 of Mathematics.

N.B.—1. A Student may not, in either year, take up more than *four* special subjects.

2. A Student who, at the end of his first year, passes with credit in History, or Geography, or both, may in his second year omit such subject, or subjects.

3. A Student who fails to pass with credit in either, or both, of these two subjects, must take it, or them, up again in his second year, and may not, in that year, take up more than *three*, or *two*, special subjects.

4. Acting Teachers, who attend the Christmas Examination, will receive additional marks for any two of the specified Science Subjects, in which they may have obtained a first or second class in the Advanced Stage or in honours, at one of the May Examinations held by the Science and Art Department.

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* For information respecting the examinations in Science and Art, and for copies of the Science and Art Directories, application may be made to "The Secretary, Science and Art Department, South Kensington, London W."

† In 1882 the passages will be taken from *Cæsar de Bello Gallico*, Book II., Virgil's *Æneid*, Book VI., Xenophon's *Anabasis*, Book II., Euripides, *Medea*, Saintine's *Picciola*, Book I., Molière's *L'Avare* or Racine's *Athalie*, Goethe's *Italian Journey*, and Schiller's *Maria Stuart*. In 1883 the passages will be taken from *Cæsar de Bello Gallico*, Book III., Virgil's *Æneid*, Book VI., Xenophon's *Anabasis*, Book III., Euripides' *Medea*, Bonnechose's *Lazare Hoche*, Molière's *L'Avare*, Goethe's *Italian Journey*, and Schiller's *Maria Stuart*.

Education Department.

Syllabus for Female Candidates.

DECEMBER, 1882.

The Examination for Certificates will commence on Monday, the 11th of December, 1882, at 3 p.m.

1. This Syllabus shows the extent of the Examination, but Acting Teachers may obtain Certificates who can *read and *write well, receive, in the case of females, a good report for *needlework, and answer simple questions confined to the following subjects:—

a. English History (leading facts).
b. Geography (elements of, and British).
c. *Arithmetic (including proportion, practice, vulgar and decimal fractions).
d. *English Composition, Spelling, and Parsing.
e. *School Management.

2. Failure in any of the subjects marked with an asterisk excludes a Candidate from a Certificate.

3. Acting Teachers attending the examination may, at their option, take the papers of the first or second year. The questions set will be such as can be answered from Text Books in common use.

4. The relative proficiency of the candidates according to examination, and also whether they were examined on the papers of the first or second year, is recorded in their certificates.

Reading and Repetition from Memory.

First Year.

To read with a distinct utterance, due attention to the punctuation, and just expression. Each *Student* must have learned at least 300 lines of poetry from the work named under Grammar (section 2), and will be called upon to repeat some part at the Annual Inspection of the Training College.

Second Year.

Candidates will be expected to show improvement in the higher qualities of Reading, such as expression, modulation of voice, and the correct delivery of long or involved sentences. Each *Student* must have learned at least 300 lines of poetry from the work named under Grammar (section 1), and will be called upon to repeat some part at the Annual Inspection of the Training College.

Penmanship.

First Year.

1. To write a specimen of the penmanship used in setting copies of text hand and small hand.
2. To write a passage from Dictation.
3. The general character of the writing in the Examination papers will be considered in deciding upon the proficiency of candidates in this subject.

Second Year.

As in First Year, but defects will be more severely visited with loss of marks.

NOTE.—Writing, as taught in schools, is apt to be too small and indistinct. Pupils should be taught to write a firm, round, legible hand.

School Management.*

First Year.

1. The methods and principles of elementary teaching generally, and with special reference to the development of the intelligence of children.
2. Notes of lessons.
3. To answer questions on the form of, mode of keeping, and making returns from, school registers. (*This part* of the paper is to be omitted by *Students* of the first year, who are proceeding to a second year's residence.)

N.B.—Special questions will be inserted in the papers for candidates who, coming from, or being about to take, Infant Schools, desire to obtain special certificates as Teachers of Infants—

a. Method of Teaching Infants, and of conducting an Infant School.
b. Notes of Object Lessons.

*Second Year.**

1. To teach a class in the presence of Her Majesty's Inspector.†
2. To answer questions in writing on the following subjects:—
   a. The different methods of organising an elementary school.
   b. The form of school registers, the mode of keeping them, and of making Returns from them.
   c. The training of the senses and of the memory; the processes of reasoning; the order in which the faculties of children are developed; the formation of habits and character,—all considered in their application to the methods of teaching and moral discipline.

Grammar and Composition.

First Year.

1. The elements of Grammar.
2. To parse words selected from a passage in Byron's *Childe Harold's Pilgrimage, Canto IV., Stanzas* 1–48 *and* 140 *to end.*
3. To analyse a passage from the above.
4. An explanation of the meaning and words in the selected passage.
5. To write plain prose upon a given subject.

Second Year.

1. To paraphrase a passage from the play of *Macbeth.*
2. To answer questions on the language, style, subject-matter, history, and authorship of the play.
3. To write plain prose upon a given subject.

Geography.

First Year.

1. Elementary knowledge of Physical Geography.
2. To describe in words, and draw the map of, the four quarters of the globe, of each country in Europe (that of Great Britain in fuller detail), and of Hindostan, Australia, New Zealand, Canada, and the South African Colonies.

Second Year.

1. The Geography, Physical, Political, and Commercial, of the British Empire.
2. Map drawing confined within these limits.

History.

(The papers will contain questions on the history of Scotland.)

First Year.‡

General outlines of British History.

Second Year.

The History of England, military, constitutional, and literary, under the Tudors (1485-1602), *or* from the year 1715 to the accession of Queen Victoria.

Arithmetic.

N.B.—The figures must be well formed, and the sums worked methodically, and as good models for children to imitate. The papers for each year will contain questions requiring an explanation of the Arithmetical processes employed.

First Year.

1. The first four rules.
2. Practice and Bills of Parcels.
3. Vulgar Fractions.
4. Decimal Fractions.
5. Simple and Compound Proportion.
6. An exercise in Mental Arithmetic.

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* Passages taken from Reading Lesson Books commonly used in schools may be given in the papers on all subjects which admit of it, and candidates will be expected to show how they would explain such passages to children. *Each paper may also contain questions on the Method of Teaching the elementary part of the subject to which it relates.*

* No Student will be examined unless the Principal certifies that she has spent at least six weeks, or 150 hours, in the Practising and Model Schools, under proper superintendence, during residence, and at least half that time during the second year's residence.

† Students to be examined under Article 105 must also teach a class in the presence of Her Majesty's Inspector.

‡ *See* Appendix.

Second Year.

1. Simple and Compound Interest, Discount, Stocks, Insurance.

Domestic Economy.

First Year.

1. Clothing.
2. Food.
3. Laundry.

Second Year.

1. Cooking.
2. Household expenses and investment of money.
3. Practical rules for preservation of health.

N.B.—Only a percentage of the marks for this paper will be given in the case of those students (of both years) who do not present a certificate signed by the Superintendent, to the effect that she is satisfied with their practical proficiency in some specified portion of the work usually comprehended under the name of Industrial Training.

Sewing and Cutting Out.

First Year.

1. To cut out and make parts of any plain article of underclothing in common use.
2. To answer questions in needlework (within the above limits) on paper.

Second Year.

1. The work of a needlewoman in various branches applicable to the family of a working man.
2. To answer questions on paper.

Vocal Music.

First Year.

1. Notation: The treble and bass staves, and the relation between them.
2. Time: Simple common, and simple triple.
3. The scales major and minor; with the intervals (major and minor, perfect or other) found in both, and the chromatic intervals found in the latter.
4. Transposition from one key to another; and transcription from one variety of time to another (as from $\frac{3}{4}$ to $\frac{6}{8}$).

Second Year.

1. Notation: The alto and tenor staves, and their relation to the treble and bass.
2. Time: compound common, and compound triple.
3. Classification of intervals, as perfect and imperfect, consonant and dissonant.
4. Resolution of individual dissonant intervals.
5. Rudiments of harmony: Positions of chords; progression, inversion; discords by suspension (on fundamental basses only); the discord of the dominant seventh (in its direct form only).

NOTE.—A *paper* on this subject is not given to any Student, about to leave the Training College, who has not passed the Musical Inspector's examination in practical skill. Acting teachers who take this paper must produce a certificate from some competent person (such as the organist of their church) that they have '*such* '*an amount of musical skill, vocal or instrumental, as* '*is sufficient for the purpose of teaching children to sing* '*from notes.*'

Drawing.

[*N.B.*—This exercise does *not* form part of the *December* examination. Annual examinations *in Drawing only* are held at each of the *Training Colleges* under inspection some time in November, and at the various *local drawing schools* in connection with the Department of Science and Art, at times to be learned from the masters of those schools. The value of the exercises is marked, and the marks carried to each candidate's total, for a certificate under this Syllabus.]

The series of exercises prescribed in the Art Directory* of the Department of Science and Art, for a drawing certificate of the second grade.

* For information respecting the examinations in Science and Art, and for copies of the Science and Art Directories application may be made to 'The Secretary, Science and Art Department, South Kensington London, W.'

Special Subjects.

Additional marks will be given to a Candidate for success in some of the following subjects, provided that sufficient marks be gained for obtaining a certificate, according to this syllabus, without counting marks for these special subjects.

I. Languages.

1. Latin.
2. French.
3. German.

Candidates may take *one* (but not more) of these languages. *Students* will be examined in those languages only for which a special course of instruction is provided in the Time Table of their College.

First Year.

This paper will contain grammatical questions, and easy passages* in prose for translation from and into English.

Second Year.

This paper will contain more difficult passages* (in poetry as well as prose), for translation from and into English prose, with questions upon the construction of particular sciences.

II. Science.

See Extracts from Minute of 17th January, 1878.
At Whitehall, the 17th day of January, 1878.

BY THE RIGHT HONOURABLE THE LORDS OF THE COMMITTEE OF HER MAJESTY'S MOST HONOURABLE PRIVY COUNCIL ON EDUCATION.

1. The Lords of the Committee of Council on Education consider the subject of Science Instruction in Training Colleges. They believe that the time has arrived when a special examination should be instituted at a period of the year better adapted to the Training Colleges than May; and that the nature of the examination and the payments made on the results should be modified to suit the circumstances of those Colleges.

2. They therefore determine that in future a special Examination in Science shall be held in the Training Colleges in December, immediately before the ordinary Christmas Examination.

3. *The examination will not be open to Acting Teachers.* It will be held in those subjects only for which a special course of instruction is provided in the time table of the College, and will be conducted by one of Her Majesty's Inspectors, or by an officer of the Science and Art Department.

4. No Student in a Training College will be allowed to attend the May examinations of the Science and Art Department.

5. The examination will be confined to the following ten subjects:—

1. Mathematics.
2. Theoretical Mechanics.
3. Applied Mechanics.
4. Acoustics, Light and Heat.
5. Magnetism and Electricity.
6. Inorganic Chemistry, including Practical Chemistry.
7. Animal Physiology.
8. Elementary Botany.
9. Physiography.
10. Principles of Agriculture.

6. No Male Student will be permitted to take up more than *two* subjects in any one year. *Women will not be permitted to take more than one science subject in a year.*

7. The examination, except for Mathematics, will be based on the syllabus of the several subjects given in the Science Directory. But the two stages, Elementary and Advanced, will be treated as a whole—one paper only being set. These examination papers will be framed much as the present May papers are framed, that is to say, with a certain number of compulsory questions and a certain number of optional questions, some of the latter being more difficult, and more highly marked, than the rest. Questions will also be set on the method of teaching various branches of the subject. The syllabus for the Mathematical examination is given in the Appendix.

8. The successful Students will be placed in the 1st or 2nd Class, the Standard for a 2nd Class being as high as that of a *good* 2nd Class in the present Advanced Stage, and for the 1st Class of a *good* 1st Class in the Advanced Stage.

* In 1882 the passages will be taken from *Cæsar de Bello Gallico*, Book II., Virgil's *Æneid*, Book VI., Saintine's *Picciola*, Book I., Molière's *L'Avare* or Racine's *Athalie*, Goethe's *Italian Journey*, and Schiller's *Maria Stuart*. In 1883 the passages will be taken from *Cæsar de Bello Gallico*, Book III., Virgil's *Æneid*, Book VI., Bonnechose's *Lazare Hoche*, Molière's *L'Avare*, Goethe's *Italian Journey*, and Schiller's *Maria Stuart*.

9. All Students who pass will be registered as qualified to earn payments on results and will receive certificates, but no prizes will be given.

APPENDIX.

1. A Student of the first year may not take up more than one language *or* one science.
2. A Student who at the end of her first year passes with credit in history or geography *may* in her second year omit one of these subjects in which she has passed with credit, and take one language *and* one Science.
3. A Student who falls below a creditable pass in either or in both of these subjects *must* take it, or them, up again in her second year.

Acting Teachers.

Acting Teachers, who attend the Christmas Examination, will receive additional marks for any two of the specified Science Subjects, in which they may have obtained a first or second class in the Advanced Stage or in honours, at one of the May Examinations held by the Science and Art Department.

——o——

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add together seven hundred and nine, eighty-four, six hundred, fifty-eight, five hundred and eighty, and four. Ans. 2035.

(2) From six hundred and eight, take one hundred and seventy-nine. Ans. 429.

(3) From seven hundred and fifty, take sixty-four. Ans. 686.

STANDARD II.

(1) From seventy-three thousand and eighty-four, take six thousand seven hundred and ninety-five. Ans. 66,289.

(2) Divide sixty-seven thousand eight hundred and thirty-six, by eight. Ans. 8479—4.

(3) Multiply sixty-nine thousand seven hundred and eight, by nine hundred and seven. Ans. 63,225,156.

STANDARD III.

(1) Write out in words the numbers,—3506, 400060, 10300, 1001. Ans. (none required for a *teacher*).

(2) A man owed bills to the amount of one thousand five hundred pounds and sixpence halfpenny. He paid first eighty-seven pounds six shillings and fivepence; then four hundred and seventy-three pounds nine shillings and eleven pence. How much did he still owe? Ans. £939 4s. $2\frac{1}{2}$d.

(3) Add together: eight hundred and three pounds sixteen shillings and fourpence halfpenny, seventy-nine pounds eight shillings and tenpence, twelve shillings and ninepence three farthings, eight hundred and seventy-four pounds three shillings and fivepence farthing, six thousand and thirty-four pounds sixteen shillings and elevenpence halfpenny.

Ans. £7792 18s. 5d.

(4) Divide four hundred and eighty-two thousand three hundred and fifty, by six hundred and fifty-one. Ans. 740—610 remainder.

STANDARD IV.

(1) Multiply seventy pounds sixteen shillings and fourpence halfpenny, by eight hundred and six; and prove the sum. Ans. £57,079 18s. 3d.

(2) The distance between two towns is 188 miles. If a train ran at the rate of 82,720 yards in an hour, how long would it take to perform the journey?

Ans. 4 hours.

(3) Divide forty thousand and seventeen pounds sixteen shillings and fourpence halfpenny, by five hundred and seventy-three. Ans. £69 16s. $9\frac{1}{4}$d.—321 remainder.

(4) Reduce forty thousand three hundred and seventy-six pounds to tons, and prove the sum.

Ans. 18 tons. 0 cwt. 2 qrs.

STANDARD V.

(1) Find, by practice only, the value of eight hundred and forty-seven yards of cloth, at 1s. $7\frac{1}{4}$d. per yard. Ans. £67 18s. $8\frac{3}{4}$d.

(2) Make out and receipt the following bill:—
8 lbs. of tea at $2\frac{1}{2}$d. per oz.
16 stone of salt at $4\frac{1}{2}$d. per stone
9 stone of sugar at 1s. 9d. per $\frac{1}{2}$ stone
3 dozen oranges at $1\frac{1}{2}$d. each.

Ans. £3 8s. 8d.

(3) In what time will 48 men do a piece of work which 39 men can do in 16 days? Ans. 13 days.

(4) Find, by practice only, the cost of 6 tons 7 cwt. 1 qr. of coal, at £1 8s. 4d. per ton.

Ans. £9 0s. $3\frac{1}{4}$d.

STANDARD VI.

(1) Add $\frac{3}{4}$, $6\frac{1}{3}$, $\frac{17}{5}$, $6\frac{1}{2}$. Ans. $16\frac{59}{60}$.

(2) Multiply 16·04 by ·32. Divide 1121·4 by ·534. Ans. 5·1328; 2100.

(3) Simplify $\dfrac{4\frac{1}{2} \text{ of } \frac{2}{5} \text{ of } 6}{\frac{1}{2} \text{ of } \frac{3}{4} \text{ of } 1}$. Ans. $28\frac{4}{5}$.

(4) Reduce 5s. to the decimal of 13s. 4d., and find the value of $\frac{3}{5}$ of $\frac{2}{3}$ of $\frac{1}{2}$ of 15s. Ans. ·375; 3s.

(5) If 8 horses plough 26 acres in 4 days, how long will 12 horses be in ploughing 39 acres?

Ans. 4 days.

Physical Geography.

(1) What is the distance round the earth?
(2) What is the diameter?
(3) How long are the days and nights at the Poles?
(4) Why have we much more heat in summer than in winter?
(5) If it is 12 o'clock at London what time is it at New York, if there is 90° between them?
(6) When it is 12 o'clock at noon at London, what is the time at St. Petersburg, which is about 30° E. of London?
(7) What causes day and night?
(8) How long does it take the earth to rotate on its axis?
(9) When is the earth nearest the sun?
(10) Place lead-pencil in similar position to earth's axis.
(11) What shape is the earth's path round the sun? One word for it.
(12) When have we full moon?
(13) " new "
(14) What is the relative position of the moon, earth,

and sun during full moon, new moon, eclipse of moon; also eclipse of sun?

(15) Why cannot we always see the moon?
(16) When do we see the moon in winter?
(17) Which of the planets is nearest the sun?
(18) When can it be seen? Why not always?
(19) Next planet? When can it be seen? What is it sometimes called?
(20) How many motions has the moon? What are they?

Grammar.

STANDARD IV.

Parse these sentences :—

(1) She took a long run.
(2) James did a just act.
(3) In return we spoke thus.

STANDARD V.

(1) Parse :—

(*a*) Having ill deserved this, I am angry.
(*b*) We lay resting among the meadow grass and flowers.

(2) Analyse :—

(*a*) To tell a lie is never right.
(*b*) He much desires to go away.

STANDARD VI.

(1) Parse :—

(*a*) If they be dead, I care not to live.
(*b*) Where can you be found?

(2) Analyse :—

It is not true that James is a better player than Henry.

Engagements for February.

February 1.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
„ 2.	Linnean Society	8 p.m.
	Royal Society	4.30 p.m.
„ 3.	Finance of Orphanage, N.U.E.T.	7.30 p.m.
	Council of Orphanage	8 p.m.
„ 4.	Organisation Committee, N.U.E.T.	10 a.m.
	Executive, N.U.E.T.	11 a.m.
„ 8.	Anthropological Society	8 p.m.
	Geological Society	8 p.m.
„ 9.	Royal Society	4.30 p.m.
„ 10.	New Shakspere Society	8 p.m.
	Finance of Prov. Soc., N.U.E.T.	7 p.m.
	General Board	8 p.m.
„ 13.	Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
	Royal Geographical Society	8.30 p.m.
„ 15.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
„ 16.	Linnean Society	8 p.m.
	Royal Society	4.30 p.m.
„ 17.	Geological Society—Anniversary Meeting	8 p.m.
	Executive, N.U.E.T.	7 p.m.
„ 18.	Organisation Committee, N.U.E.T.	10 a.m.
„ 20.	Central Committee of Benevolent Fund, N.U.E.T.	7.15 p.m.
„ 22.	Geological Society	8 p.m.
	Anthropological Society	8 p.m.
„ 23.	Royal Society	7.30 p.m.
„ 24.	Browning Society. Papers by J. T. Nettleship, Esq., and Miss Lewis	8 p.m.
„ 27.	Finance and General Purposes Committee, N.U.E.T.,	7.30 p.m.
	Royal Geographical Society	8.30 p.m.

Publications Received.

Arithmetic—

(1) Farnsworth's Domino Cards. J. B. Ledsham.

Drawing—

(1) Sweeting's Drawing Copy Books—Geometry. Walker & Co.

French—

(1) Grammar of the French Language. National Society.

Geometry—

(1) Wright's Lessons on Form. Longmans & Co.

General Literature—

(1) Maria Wuz and Lorenz Stark. Longmans & Co.
(2) Crawley's Handbook of Competitive Examinations. Longmans & Co.
(3) Bosco's History of Modern Italy. Longmans & Co.
(4) Bret Harte's George Washington Æsop's Fables. Hamilton.
(5) Mack's Scrap Packet. W. Mack.
(6) Dawson's Pamphlet on School Libraries. Bale & Sons.

Grammar—

(1) Nesbit's Grammarland. Third Edition. Houlston & Sons.

Greek—

(1) Arnold's Greek Prose Composition. Rivingtons.

Literature—

(1) Arnold's Poetry and Prose. Longmans & Co.
(2) Reade's How to Write English. J. H. Houghton.

Music—

(1) Choral Festival Music Book. Wesleyan Methodist S.S. Union.
(2) Wesleyan Methodist Tune Book. Wesleyan Methodist S.S. Union.

Periodical Literature—

(1) Our Little Ones. III. Griffith & Farran.
(2) Universal Instructor. XV. Ward, Lock & Co.
(3) The Oxford Examiner. I. E. Stanford.
(4) The Cambridge Examiner. E. Stanford.

Poetry—

(1) Palmer's Temptation of Job, and other Poems. Philip & Son.

Prize Books—

(1) Kilkee. Wesleyan Methodist S.S. Union.

Science—

(1) Watt's Scientific Industries Explained. Vol. II. W. & A. K. Johnston.

Sunday-School Literature—

(1) Senior and Junior Scholars' Tablets for '82. Wesleyan Methodist S.S. Union.
(2) Scripture Lesson List. Wesleyan Methodist S.S. Union.
(3) Anecdotal Illustrations of St. Mark. Wesleyan Methodist S.S. Union.
(4) Pleasant Talks about Jesus. Wesleyan Methodist S.S. Union.
(5) Wesleyan Methodist S.S. Magazine. 1881.
(6) Our Boys' and Girls' Volume. 1881.
(7) Our Boys' and Girls' Double Volume. '80 & '81.

Bell's 'Standard Elocutionist,' lately published by Messrs. Mullan & Son, has been purchased by Messrs. Hodder & Stoughton, who are now issuing the hundred-and-first thousand.

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The Editor cannot return rejected MSS.; authors should therefore retain copies.

*** *We regret that, owing to the great pressure upon our space, the 'Monthly Notes' and 'Gossip' are again crowded out.*

'How I Teach Arithmetic.'

(*Continued from page* 557.)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

(*b*) After simple interest, naturally comes *Compound Interest*, which we at once proceed to consider. I first explain and illustrate the difference between simple and compound interest, that at simple interest the money due as interest is assumed to be paid when it is due—yearly or half-yearly generally. At compound interest, however, the interest is assumed as not paid, but is, when due, added to the principal, which consequently causes the interest to increase at an accelerated ratio. I should illustrate somewhat as follows:—I place out at interest two sums, each of £100, say in a bank, one of the sums being placed at simple interest, and the other at compound, the interest on each at 5 per cent. being due yearly. At the end of the year I receive the £5 due on the amount out at simple interest, but instead of receiving the £5 due on the other £100 I have it added to the £100, so that the banker has now £105 of mine, on which £105 the interest for the second year will have to be reckoned. For this second year the £105 will make £5 5s. interest, which now added to the £105 will make the principal £110 5s. for the third year. The interest on this last sum will be £5 10s. 3d., which added to the £110 5s. = £115 15s. 3d., the *amount* of £100 in the 3 years, or the principal for the 4th year if we wish to proceed any further. Hence the *compound* interest on the £100 for 3 years is £15 15s. 3d., while the *simple* interest on the other £100 is only (£5 × 3 =) £15; so that the compound interest is 15s. 3d. more than the simple interest.

(*b1*) We will now work an example or two requiring the *compound interest of a given sum for a given time*:—Find the compound interest of £7650 for 4 years at 2½ per cent. per annum. When the rate per cent. is a sub-multiple of 100, as $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$, etc., compound interest may be worked and represented most succinctly somewhat in the form of a practice sum as below, the work being performed decimally in £'s in preference to shillings and pence.

	£	
2½ p. c. is $\frac{1}{40}$	7650	
	191·25	int. for 1st yr.
„ „ $\frac{1}{40}$	7841·25	prin. for 2nd yr.
	196·03125	int. for 2nd yr.
„ „ $\frac{1}{40}$	8037·28125	prin. for 3rd yr.
	200·93203125	int. for 3rd yr.
„ „ $\frac{1}{40}$	8238·21328125	prin. for 4th yr.
	205·95533203125	in. for 4th yr.
	8444·16861328125	amt. in the 4 yrs.
	7650·	the original prin. deducted
Answer	£794·16861328125	compd. int. for the 4 yrs.
	20	
	s. 3·3722656250	
	12	
	d. 4·4671875	

Another example:—A young man who enters a situation at the age of 21, lays by out of his salary £20

at the *end* of each year, and invests his savings at 5 per cent. compound interest; what will he be worth at the age of 25?

£20 1st year's saving, or worth at 22 years of age.
 1 interest on the above.
20 2nd year's saving.
—
41 worth at 23
 2·05 interest on the above.
20· 3rd year's saving.
———
63·05 worth at 24.
 3·1525 interest on the above.
20· 4th (last) year's saving.
£86·2025 = £86 4s. $0\frac{3}{5}$d. Ans.

Five per cent. being $\frac{1}{20}$, the interest is found by taking successively $\frac{1}{20}$ of the principal, or his worth at each year.

In compound interest the interest is sometimes considered as due *half* yearly, when, of course, the interest for each *half* year must be added successively to the preceding principal. For instance, we see how many half years there are in the given time, and add so many times half-a-year's interest. If the rate be 5 per cent. add $\frac{1}{40}$ instead of $\frac{1}{20}$, if 4 per cent. add $\frac{1}{50}$ instead of $\frac{1}{25}$, or whatever the *modus operandi* for obtaining the interest, get half-a-year's only. Of course the oftener the interest is added to the principal the more rapidly the amount increases, as the following example will show. What is the difference of compound interest, between being payable yearly and half-yearly, of £575 at 4 per cent. for two years?

$\frac{1}{25}$	575£	$\frac{1}{50}$	575£
	23.		11·5
$\frac{1}{25}$	598	$\frac{1}{50}$	586·5
	23·92		11·73
	£621·92	$\frac{1}{50}$	598·23
			11·9646
		$\frac{1}{50}$	610·1946
			12·203892
			£622·398492

£622·398492 amount half-yearly.
621·92 „ yearly.

£·478492 = 9s. 6·83808d. Ans.

Explain to the class clearly the result obtained—that nearly 9s. 7d. more would be made as interest by being reckoned as due half-yearly instead of yearly. I should point out also that if the interest was reckoned quarterly, the increase would be still greater; and as the operation would be very easy, though rather lengthy, by simply adding $\frac{1}{4}$ of $\frac{1}{25}$ or $\frac{1}{2}$ of $\frac{1}{50} = \frac{1}{100}$ to the principal eight times, I would have it worked out, and then compare the *three* results.

($b2$) We will now *find the principal* that will amount to a certain sum, or produce a given interest in a given time. Here the principle and process are identical with those for simple interest given under $a4$. Without further comment we will therefore work out a short example. What principal will amount to £5000 in 2 years at 5 per cent. compound interest? Here we first find what £1, or £100—which I prefer, and therefore generally take—would amount to in the time. £100 + 5 = £105 amount in 1 year, and £105 + $5\frac{1}{4}$ = £$110\frac{1}{4}$ amount in 2 years—5 per cent., that is $\frac{1}{20}$, being added in each case. As £100 amounts to $110\frac{1}{4}$, the principal is $\frac{100}{110\frac{1}{4}} = \frac{400}{441}$ of the amount; hence $\frac{400}{441}$ of £5000 = £4535 2s. $11\frac{65}{147}$d. Ans. As I have a firm belief of the utility of working out the same question by a variety of methods, I would find out what £1 amounts to, and then work it out decimally—thus, as £100 amounts to £110·25, £1 would amount to £1·1025, then as often as this last number will go in the £5000 will be the result in £'s. In dividing the £5000 by £1·1025, if the figures are continued as decimal of a £, they will not terminate, and consequently the *exact* answer as above would not be obtained, though if continued far enough would be sufficiently near for all practical purposes—to the infinitesimal decimal of a penny. By multiplying each number, however, by 10,000 we have £50,000,000 ÷ 11025, the decimals being eliminated, so that now it is simply compound division. In compound interest *the finding of the rate per cent.* as well as *the finding of the time*, corresponding to $a2$ and $a3$ respectively in our remarks on simple interest, are rarely attempted without the use of logarithms; here, therefore, we close our exposition of the teaching of interest.

(c) *Discount* naturally follows interest, and therefore to it we at once proceed. I first try to make clear the meaning of the term discount—something taken off an account for paying it before due. I suppose that I owe a person £105 due one year hence, and that money is worth 5 per cent. Well, he wants the money *now*, and I happen to have £100 to invest, so that I might either invest my £100 for a year making £5 interest and thus amounting to £105, or if he choose, instead of lending the £100 to a third party, I can pay him the £100 direct which will make *him* £5 interest. Hence at the end of the year, when the £105 is really due, he has got his full amount—£105. I have paid him £100 instead of £105, the £5 being discount, and the amount actually paid, called *the Present Worth, if put out at interest would make exactly the same money as has been taken off for discount.* These words in italics express the principle on which discount is based, and must be indelibly impressed on the memory, as well as clearly understood. Hence in order to find the discount of *any* sum of money, find what £100 would amount to at the given rate and for the given time—as in the above £100 amounts to £105,—then the present worth of £105 is £100, consequently the discount on £105 (mind, not on £100) is £5, that is $\frac{5}{105} = \frac{1}{21}$ of the given sum. Here explain clearly the meaning of Present Worth (generally expressed P.W.), and show the fitness of the term—*worth* at the *present* time.

($c1$) We will now work out a few examples and make them the basis of any explanatory remarks:—*First, when the discount or P.W. is required.* What is the discount on £19 12s. 9d. due $2\frac{1}{2}$ years hence at 4 per cent. simple interest? £4 × $2\frac{1}{2}$ = £10 interest of £100 for the time, hence £100 would amount to £110; consequently the P.W. would be $\frac{100}{110}$, and the discount $\frac{10}{110} = \frac{1}{11}$ of the given sum; hence $\frac{1}{11}$ of £19 12s. 9d. = £1 15s. $8\frac{5}{11}$d. Ans.

What is the present worth of £50 due in 100 days at $3\frac{1}{2}$ per cent? First, 100 days $=\frac{100}{365}=\frac{20}{73}$ year, and £$\frac{7}{2}\times\frac{20}{73}=$ £$\frac{140}{146}=\frac{70}{73}$ interest of £100, hence £100 amounts to £$100\frac{70}{73}$; consequently the Present Worth equals $\frac{100}{100\frac{70}{73}}=\frac{7300}{7370}=\frac{730}{737}$ of the money given, and $\frac{730}{737}$ of £50 = £49 10s. $6\frac{18}{737}$d. Ans.

Discount is generally reckoned on the theory or principle of *simple* interest, but for long periods it should be based on *compound* interest, otherwise the payee gains an advantage to the detriment of the payer. What is the discount of £750 due 2 years hence at 5 per cent. *compound* interest? Here £100 at compound interest would make £10 5s. in the two years, but at simple interest only £10; hence, as before shown the discount will be $\frac{10\frac{1}{4}}{110\frac{1}{4}}=\frac{41}{441}$ of £750 = £69 14s. $6\frac{34}{49}$d. Ans. Had simple interest been reckoned the result would have been $\frac{10}{110}=\frac{1}{11}$ of £750 = £68 3s. $7\frac{7}{11}$d.

(*c*2) We will now *find the original amount* when the present worth, time, and rate are given:—A person pays £725 ready cash for a bill due 8 months hence at 4 per cent.; what was the amount of the bill? Eight months $=\frac{2}{3}$ year, then £$4\times\frac{2}{3}=$ £$2\frac{2}{3}$ interest of £100; hence £100 would amount to £$102\frac{2}{3}$, that is, the P.W. is $\frac{100}{102\frac{2}{3}}=\frac{300}{308}=\frac{75}{77}$ of the full debt; or the full debt is $\frac{77}{75}$ of the P.W., and $\frac{77}{75}$ of £750 = £744 6s. 8d. Ans. Working on the basis italicised under *c*, the operation may be more easily performed; thus, £725 being the P.W., it would amount to the original sum in 8 months at 4 per cent. £$725\times\frac{1}{25}\times\frac{2}{3}=$ £19 6s. 8d. the interest, or in other words the discount that has been taken off; then £725 + £19 6s. 8d. = £744 6s. 8d. Ans.

(*c*3) We now proceed to *find the rate per cent.*, the other data being given. Here all that is required is an intelligent appreciation and application of the principle quoted under *c* and just applied above—*e.g.*, I owe a bill of £12 17s. 6d. due in 8 months, which I at once discharge by paying £12 10s.; what rate of discount am I allowed? It is evident from the data that 7s. 6d. is the interest of £12 10s. for 8 months, then 7s. 6d. $\times 1\frac{1}{2}$ (a year being $1\frac{1}{2}$ times 8 months) = 11s. 3d. the interest of £12 10s. for a year. Now £100 is just 8 times £12 10s., then 11s. 3d. $\times$ 8 = £4 10s. Ans.

Another example:—A bill of £841 3s. 4d. due in 9 months is cashed for £816 13s. 4d.; what rate per cent. per annum discount was allowed?

	£	s.	d.	
	841	3	4	
	816	13	4	
3)	24	10	0	int. of £816 13s. 4d. for 9 months.
	8	3	4	" " 3 "
	32	13	4	" " 12 "

Now £816 13s. 4d. $=8\frac{1}{6}$ *hundreds* of £'s, and £32 13s. 4d. $\div 8\frac{1}{6}=$ (£196 $\div$ 49 =) £4 rate per cent. Ans.

(*c*4) Lastly, we will *find the time* in which a sum of money would have been due—*e.g.*, a bill of £152 5s. is cashed for £150 at $4\frac{1}{2}$ per cent. per annum discount; in what time would it have been due? Applying our principle as previously, £150 would amount to £152 4s. in some *unknown* time at $4\frac{1}{2}$ per cent; that is, £150 would make £2 5s. interest in the unknown time at $4\frac{1}{2}$ per cent. Now £150 would make £$4\frac{1}{2}\times 1\frac{1}{2}$ = £$6\frac{3}{4}$ = £6 15s. in a *year*, hence whatever number of times, integral or fraction, that £2 5s. is (of) £6 5s. is the answer in years. As £2 5s. is $\frac{1}{3}$ of £6 5s. the time is $\frac{1}{3}$ year = 4 months. Ans.

From the explanations and workings under the above four heads, with an unlimited number of questions for class-work, I find that boys of average intelligence are soon able to work any ordinary question in discount however presented.

In closing our remarks on discount, we ought to mention that spurious kind called *Bankers' Discount*, which is simply discount reckoned as interest. For instance, I wish to cash a £100 bill, due 3 months hence at 4 per cent. The true discount would be $\frac{1}{101}$ of the £100 = 19s. $9\frac{63}{101}$, but the bankers' discount would be simply the interest of £100 for the 3 months, that is £1, hence the advantage to the banker of nearly $2\frac{1}{2}$d. This bankers' discount is also sometimes called traders' discount, where the slight advantage of course is with the pay*er*. Three days' grace can be legally claimed by the person or firm on whom a bill is drawn, so that it is not properly payable until three days after its *date* for payment.

(To be continued.)

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Publications Reviewed.

*** We are sorry to disappoint the many friends who desire us to quote the price of each work noticed in our columns. This we would respectfully point out is the publishers' duty and not ours; we give publicity enough to a book when we review it. Our readers should peruse the advertisements in our pages, and failing to find the price here, it would be no great trouble or expense to drop a line to the publishers whose name and address we will gladly give.

The Teacher's Handbook to the Circle of Knowledge. By the late Charles Baker. London: 67, Paternoster Row.

The well-known series entitled 'The Circle of Knowledge,' comprised an extensive compendium of all kinds of facts arranged in grades suitable to what we now term the different 'Standards.' The series proceeded under the assumption that the inculcation of information on every branch of knowledge was the main purport of education. But this cramming process—for such it really is—ignored to a great extent the cultivation of the reasoning powers, and left less room for taste, imagination, and fancy. By general consent the Gradgrind system was discouraged, and children were not condemned to read mere collections of facts. The book before us, however, is less open to the above objections, on account of its being designed for the use of teachers, and not as a reading-book for children. As a compendium of information it is doubtless valuable, and will save much trouble in hunting for materials for object-lessons, and the information contained in ordinary cyclopedias, together with a great deal of that which would have to be sought for in dictionaries. The statement conveyed in each 'lesson' is accompanied on the opposite page by a list of words, with their derivations and explanations. This occupies one column of the elucidatory page, the remaining column being made up of well-arranged questions on the subject-lesson. To some, these questions may be useful, but good teachers know that youthful intelligence

must be probed by question upon question, according to the answer given, and the mere set answer to a formal question be discouraged. It is, indeed, this probing process that develops true education. The final result may be gathered up, or may be often left unstated, like the *answer* of a sum, which, though apparently the most important part of an arithmetical operation, bears no comparison to the educational value of the *process* by which the result is attained. Leading questions thus employed have their use, and are free from the delusive notion of merely taking a question and its answer *without*—as a school-boy would say—*doing the sum*.

The so-called 'lessons' contain material enough in the way of facts and words for at least three or four ordinary lessons. To 'read, mark, and learn' should ever be accompanied with the remaining and most important part to 'inwardly digest.' It is by this means, and this alone, that intellectual strength is attained. A good teacher will not be annoyed at frequent forgetfulness of facts on part of little pupils, but be ready to say with Romeo—'And I'll still stay to have thee still forget.'

Scientific Industries Explained. By Alexander Watt. Edinburgh and London: W. and A. K. Johnston.

This, we ought to have indicated in the title, is the second vol. on Scientific Industries, the first of which we have already had to notice. The book before us begins with an explanation and description of the electric light. By the aid of several good illustrations the explanatory text brings this interesting subject within the comprehension of intelligent youthful readers. Among other applications of electrical action, this little volume treats of the deposition of alloys, electro-timing, and electrotyping in general. The telephone is also described. Perhaps the most interesting chapters are those on nickelplating and the use of tungstate of soda and other anticombustible appliances. This second volume is altogether a worthy sequel to its predecessor, and an interesting reading-book withal. Some valuable hints are given on the preservation of fish, meat, and other kinds of perishable food by means of salt, sugar, or by the application of a few well-known acids. To know that meat or fish immersed for a short time in water containing a small quantity of creosote will keep good for some time in very hot weather, is important to every housekeeper. To be aware also that by being immersed in a vegetable acid, such as wood vinegar, meat and fish will keep good for an indefinite period is of more value still to the thoughtful housewife. We have also some interesting accounts of the processes of preparing the tinned or canned meats, and other kinds of food, together with the now important process of refrigeration. After being landed in good condition on our shores after a long voyage, all that seems now wanting to ensure a continuous stock and supply of good fresh meat is the construction of refrigerating cellars or chambers at our ports or markets.

How to Write English. By A. Arthur Reade. Louth, T. H. Houghton; and London, Marshall and Co.

The study of English is greatly increasing, and its importance more and more appreciated. The command which some celebrated speakers and writers acquired over our language was often erroneously attributed to the influence of a classical education. But this is shown to be erroneous by the powerful clearness of writers unacquainted with Latin or Greek, as Bunyan, Cobbett, and Defoe. The labour, however, of translating and rearranging words gives power to the classical student over his mother tongue, irrespective of the nature or peculiarities of the foreign language he studies. This truth of the need and value of labour, great and incessant, to attain facility—we talk not of perfection—in plain English is shown by Mr. Reade to be indispensable. In the examination papers of pupil-teachers failure in English composition is most common. Of course the necessity of labour is first to be seen, and next the wise direction of effort is no less important. Genius, according to some of our best thinkers, is the result of painstaking effort. Sydney Smith observed that 'A man proves a miracle of genius because he has been a miracle of labour.' In a similar manner Carissimi, when praised for the gracefulness and ease of his melodies, replied, 'Ah! questo facile quanto e' difficile!' which we may translate by, 'Ah! with what difficulty is this ease acquired!' Perhaps no writer shows more apparent spontaneity and freshness than Dickens, and yet a glimpse at Dickens' manuscripts show the exceeding care and frequent revision with which he wrote. Every branch of human effort tells the same tale, that the perfection of art is attained by great labour with the result of the apparent absence of all art. The study of the best authors Mr. Reade wisely shows has an imperceptible though real influence in regard to style. Among modern writers Macaulay stands deservedly high in regard to vigour, animation, copiousness, clearness, and pure English. His English was often homely, but never vulgar. Mr. Ruskin's style is so perfect that people are apt to value his sayings even more for their manner than their matter. We are especially glad to find Mr. Reade eschews the fine writing in which penny-a-liners are often tempted to indulge, and gives us some amusing examples from the *Daily Telegraph*, who told the public that the miners' grievances 'found a friendly echo in the philanthropic breast of Lord Shaftesbury.'

Dr. Johnson's unread writings and much-read talk are an excellent commentary on the unsuitableness of the former and the attractive force of the latter. This is amusingly exemplified in one of his letters to Mrs. Thrale in which he wrote:—'When we were taken upstairs, a dirty fellow bounced out of a bed in which one of us was to lie.' This was changed by the Doctor in his book for the following:—'Out of the bed on which we were to repose there started up at our entrance a man as black as a Cyclops from a forge.' This love of fine words is often a snare. An earnest preacher once evidently taken with the word *solitude* thus impressed it upon his hearers:—'The devil tempts us sometimes in our solitude, and sometimes when we are alone!'

We have transgressed our limits, or would also commend the good taste of Mr. Reade in recommending the avoidance of slang and vulgarity on the one hand as thoroughly as he discountenances fine writing, technicalities, foreign words, and in short any departure from what people most readily understand, and which refuses to court a smile by pandering to a low taste. The grammatical details are given in as readable and pleasant style as the general introductory recommendations. Altogether the book is much to be commended.

Board-School Gymnastics, for Home and School use. By Alfred T. Story. London: L. N. Fowler, Ludgate Circus.

Gymnastics has long formed a part of education, and is coming more and more into use. Boys have made cricket and their other athletic games increasingly popular since Hughes, Kingsley, and others associated physical exertion very closely with Christianity. With girls, gymnastic exercises have been mostly restricted to a few perfunctory performances with a back-board, a few rings, and a little irregular exercise with the dumb-bells. The little book before us gives a systematic course of exercises by which uniform and healthy development of the bodily powers can be attained. The author wisely observes that, 'What is required is not to make acrobats and athletes of children,' and that 'the simpler movements of the wand and dumb-bell exercises can be done by the youngest children.' The appliances recommended are so simple and inexpensive—comprising a few plain rods or wands, a few pairs of wooden dumb-bells, and a number of wooden rings—that the cost is simply next to

nothing. The exercises are not only clearly described, but what is of far greater importance, accompanied with clear illustrations, and advice as to the number of times each exercise should be repeated. Of course these exercises fail in the zest of enjoyment that good games impart, but games of an athletic kind for girls seem yet to be developed. The battledore and shuttlecock is a poor and mostly solitary affair, and the skipping-rope involves violent exertion that is liable to result in colds taken by subsequent rest. Another hindrance to good out-of-door games for girls is the want of room except under favourable circumstances. With these difficulties, a careful resort to such regular exercises as this book details is to be recommended as almost indispensable for health.

English Poetry and Prose, selected and edited by Thomas Arnold, M.A. London: Longmans, Green, and Co.

This collection on the lines of Chambers' 'English Literature' and innumerable others, contains specimens from most authors of repute, chronologically arranged, from the latter part of the seventh century, beginning with Caedmon (A.D. 680), down to the present date, marked by the recent death of Carlyle. No living author being quoted, the editor has thereby avoided invidious comparisons; but in a book of such comprehensive design we ought surely to find the names of Adam Smith, Bloomfield, Franklin, Alison, Burney, Elliott, Ellis, Palgrave, Nicol, and many others of unquestionable repute. Surely we ought to expect that the names of Bulwer and Disraeli would find a place beside that of Thackeray! Of course many omissions must be made in any book of selections, but these omissions ought to comprise the less known instead of the most popular and well-known authors. We fail also to fall in with some of Mr. Arnold's headings. The term Anglo-Saxon, we thought, was now being shunned by all thoughtful writers. The writers of the pre-Norman period may be classified under the term Old English, instead of this latter term being arbitrarily forced to do duty for Chaucer and his times. The term Renaissance is scarcely applicable, we think, to the literature of the early Tudors. In fact, these headings, unless chronological, ought to be free from unauthorised and fanciful terms. We are grateful for the translation appended to the extracts from Alfred and a few other writers of the early English period. This is followed by a copious footnote explanation of obsolete words from the latter part of the 13th to the middle of the 16th century, when the language approached its present form. The brief introductory notes are perhaps not to be complained of, as the book is professedly a sequel to, and designed to be used with, the author's 'Manual of English Literature.'

Handbook of Competitive Examinations. London: Longmans and Co.

We feel sure that many of our readers will thank us for drawing their attention to this really valuable handbook. Candidates for admission to any department of Her Majesty's service will find it indispensable. Dr. Crawley has done his work admirably. The book has the additional merit of having been corrected up to date 1882.

The River Singers. By William Robson. London: Wesleyan-Methodist Sunday-School Union.

We have nothing but commendation to express in regard to this book, which gives us an account of the influences of religion on the most ignorant of our neglected juveniles.

Senior Scholar's Tablet-Book for 1882. London: Wesleyan-Methodist Sunday-School Union.

These neat little books are brimful of good matter or every Sunday throughout the year. Headed by a well-drawn outline illustration—excellent for a small exercise in drawing—we have the Scripture lessons for the day, followed by an important passage called the Golden Text, a Hymn Verse, and two leading questions on Christian faith and duty. On the obverse, or page following, we have a page of Home Questions on these lessons, with blank lines for the written answers. The Tablets being in turn to be detached, renders a stiff cover perhaps needless. The books and the arrangements are highly to be commended.

Junior Scholar's Tablet-Book for 1882. London: Wesleyan-Methodist Sunday-School Union.

This book for junior scholars is on the same plan and marked by the same carefulness as that for seniors, but with of course easier questions and exercises.

Kilkee. By Eliza Kerr. London: Wesleyan-Methodist Sunday-School Union.

The locality of this juvenile story is on the north-west coast of Ireland, the wild grandeur of the scenery being descriptively interwoven with the incidents of the tale. Amid exciting and by no means unnatural adventures, the good conduct of a Sunday-school boy wins general attention and respect for his religious principles. His enemies are subdued by his forgiving spirit, combined with unflinching courage under dangers. One of his bitterest enemies died in peace on being assured of the forgiveness of Willie, the little hero of the tale. There is nothing of the sensational school, though plenty of incident, in this highly-commendable little tale.

Fables. By G. Washington Æsop and Bret Harte. London: E. Hamilton, Paternoster Square.

This little brochure may amuse 'children of an older growth' who will not be misled by the undisguised cynicism which pervades its pages. Some familiar fables are cleverly travestied and accompanied by humorous though roughly-drawn illustrations. The moral, often far-fetched, is not the less humorous on that very account.

Our Little Ones. January, 1882. London: Griffith and Farran.

This is a very good number of a periodical, of which we have, on more than one occasion, spoken well.

Mack's Scrap Packet. London: W. Mack.

In this packet there are two hundred different pictures, suitable for placing in a child's scrap-book. Some of the illustrations are of rare beauty.

The Anchor Pens. London: J. Walker and Co.

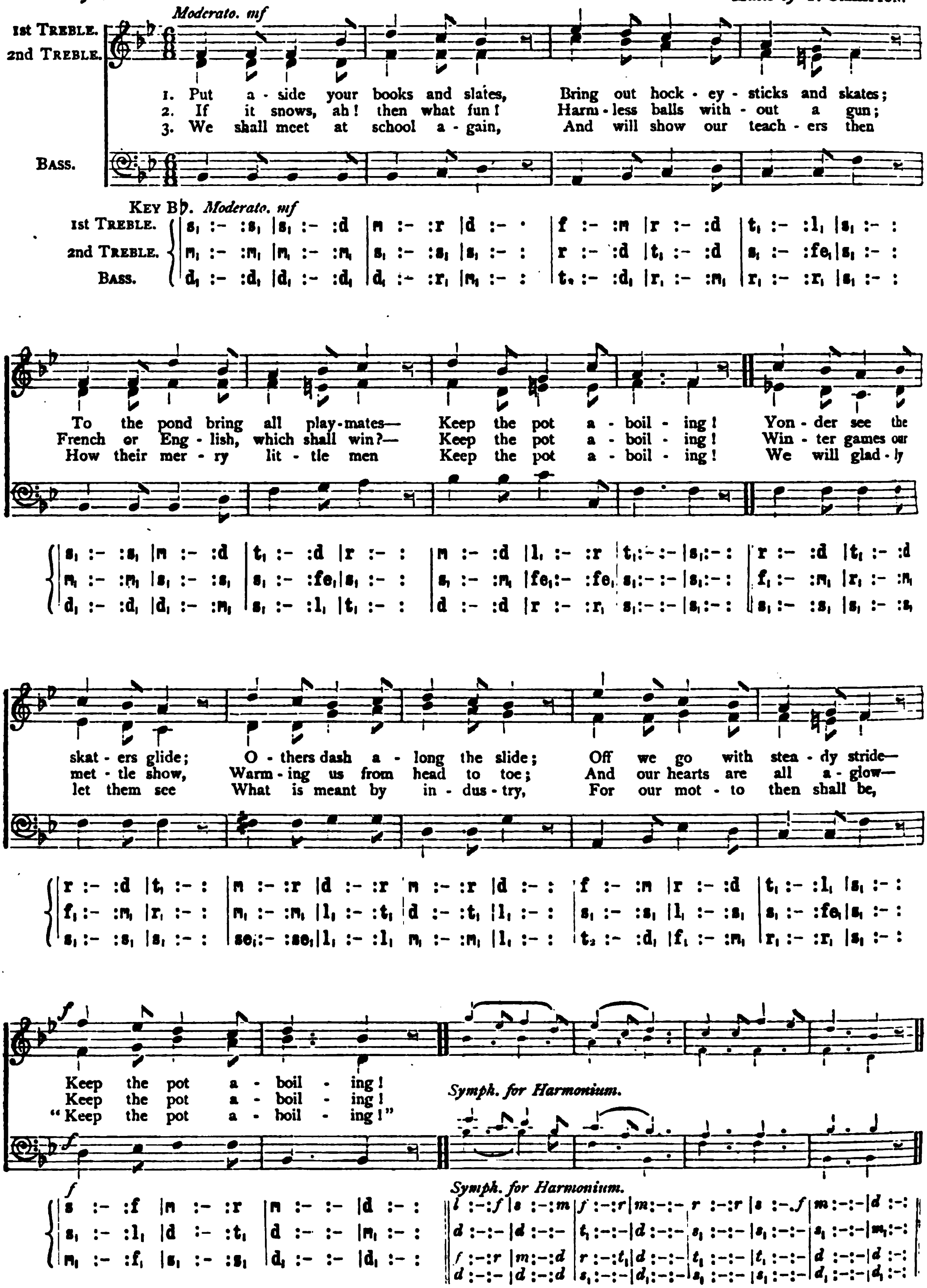
Messrs. Walker and Co. have sent us several boxes of their new anchor pens. We have used No. 3 (Broad Points) instead of the ordinary J pen, with thoroughly satisfactory results. The anchor pens are not only easy to write with, but hold an unusual quantity of ink.

Wesleyan-Methodist Sunday-School Magazine for 1881. London: 2, Ludgate Circus Buildings, E.C.

This charmingly-bound volume, brimful as it is of useful and entertaining matter, deserves a wide circulation. Many of the contributors are trained teachers of the ripest experience, Mr. Bailey, Headmaster of the Southlands College, and Mrs. Greenup being among the number. The papers supplied by the contributors just named are of special value, particularly to the young teacher. It would be hard to find a more suitable present for a Sunday-school teacher than this excellent volume.

SLIDING SONG.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.



We beg to announce that any of the songs which have appeared in the back numbers of the PRACTICAL TEACHER may now be obtained separately, price 6d. per dozen, post free.

Query Column.

☞ **As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'**

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.
2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.
3. Replies will not be sent through the post.
4. Correspondents are requested to write *legibly*, and on one side of the paper only.
5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.
6. Queries must reach the office *not later than the 15th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed

'The Query Editor,'
The Practical Teacher
Pilgrim Street, Ludgate Hill,
London, E.C.

Arithmetic.

1. YELSERP, Southampton.—A company is formed in which the liability of each partner is limited to the amount of his shares. There are 500 shares of £10 each; after 3 calls have been made of £2 on a share, it is found that the concern is a failure, and its affairs are wound up. At this period its assets amount to £10,217 0s. 0¾d. and its liabilities to £15,763 17s. 6d. How much will the company be able to pay in the pound after all the remaining calls are paid up?

Amount to be called up = (500 × 4) £
= £2000

£	s.	d.		£		£	s.	d.	
∴ 15763	17	6	:	1	::	12217	0	0¾	: Dividend.

```
  20                  20
-------            --------
 315277             244340
     12                 12
-------            --------
3783330            2932080
      4                  4
-------            --------
1513332ø           11728323
                         20
                   --------
            )23456646ø( 15s. 6d. Ans.
             1513332
             -------
             8323326
             7566660
             -------
              756666
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2. J. SKELETON, Jersey.—(*a*) A person invests £4620 in the 3 per cent. Consols at 92; what income does he receive, the brokerage being 2s. 6d. in the £? (*b*) Also what amount does he receive annually from his investment, after deducting an income-tax of 7d. in the £?

(*a*) Income on £1 $= \frac{3}{92\frac{1}{8}}$ £

∴ Income $= \frac{3 \times 4620}{92\frac{1}{8}}$ £

$= \frac{3 \times \cancel{4620}^{420} \times 8}{\cancel{737}_{67}}$ £

$= \frac{10080}{67}$ £

= £150 8s. $11\frac{31}{67}$d.

(*b*) Net income on £1 = 19s. 5d.

∴ Net income = 19s. 5d. × $\frac{10080}{67}$

$= \left(\frac{233}{\cancel{240}} \times \frac{\cancel{10080}^{42}}{67}\right)$ £

$= \frac{9786}{67}$ £

= £146 1s. $2\frac{22}{67}$d.

3. P. M'PHERSON, Glasgow.—We shall be pleased to give you all the assistance we can, but you ought not to send *unstamped* letters, leaving us to pay double postage.

A family of 14 persons has provisions for 30 days; after 21 days 4 more persons arrive: how long will the food last?

After 21 days the provisions would have lasted the original number, 9 days.

Total number of persons = 18.

∴ 18 pers. : 14 pers. :: 9 days : Time the remainder of the provisions will last;
= 7 days.

∴ The provisions will last 21 days + 7 days = 28 days.

4. MONTE CRISTO.—A gentleman bequeaths ½ of his estate to his son, and ⅓ of it to 3 friends (A, B, C) in shares, in the ratio of 3:2:1; he afterwards disposes of £500, and then divides the residue between B and C in shares, in the ratio of 4:1. If C's portion comes to £6,500, how much does each of the others receive?

C's portion $= \frac{1}{6}$ of $\frac{1}{3}$ of the estate $+ \frac{1}{5}$ of ($\frac{1}{6}$ of the estate − £500)
$= \frac{1}{18}$ of the estate $+ \frac{1}{30}$ of the estate − £100
$= \frac{5+3}{90}$ of the estate − £100
$= \frac{4}{45}$ " " − £100

∴ $\frac{4}{45}$ of the estate − £100 = £6,500
$\frac{4}{45}$ of the estate = £6,600
∴ The estate = £6,600 × $\frac{45}{4}$
= £74,250.

Son receives ½ of the estate = £37,125.
A " $\frac{3}{6}$ or ½ of ⅓ of the estate = ⅙ of the estate = £12,375.
B " £37,125 − (£12,375 + £6,500 + £500)
= £37,125 − £19,375
= £17,750.

5. X. Y. Z.—Two boys start at the same instant from the same corner of a square, the length of one of whose sides is 200 yards, and they ran round it in opposite directions. One (A) runs at the rate of 100 yards in 15 seconds, and loses two seconds in turning a corner; the other (B) runs at the rate of 100 yards in 16 seconds, and loses one second in turning a corner. Where do they meet?

A arrives at the first corner in 30 seconds,
and B " " " " 32 " :
A turns the first corner in 32 seconds,
and B " " " 33 " :

A arrives at the opposite corner in 62 seconds,
and A turns the opposite corner in 64 seconds :
Now in $(64-33)$ or 31 seconds B has run $\frac{31}{32}$ of 200 yards ;
$\therefore$ B is $\frac{1}{32}$ of 200 yards or $6\frac{1}{4}$ yards from the opposite corner.

Point where they meet $= \frac{16}{15+16}$ of $6\frac{1}{4}$ yds. from opposite corner

$$= \left(\frac{\cancel{16}^{\,4}}{31} \text{ of } \frac{25}{\cancel{4}}\right) \quad " \quad " \quad "$$

$= \underline{3\frac{7}{31} \text{ yds. from opposite corner.}}$

6. KAPPA, Weston-super-Mare.—Water runs into a cistern by one pipe and from it by two, in each pipe at a uniform rate when the pipe is open. The cistern holds 1,000 gallons. If all three pipes be open at once, the cistern supposed full, would empty itself in 200 minutes. If one escape pipe and the supply pipe only be open, it would, if empty, fill in 200 minutes. But if the other escape pipe and the supply pipe be open, in 100 minutes. How long would it take the two escape pipes to empty the cistern if the supply pipe were closed? (London Matric., June, 1881.)

Quantity emptied in one minute when all the pipes are open
$= \frac{1}{200}$ of 1,000 gallons
$= 5$ gals.

Quantity filled in one minute when the supply pipe and first escape pipe are open $= \frac{1}{200}$ of 1,000 gals. $= 5$ gals.

$\therefore$ Quantity emptied in one minute by second escape pipe
$= (5+5)$ gals.
$= 10$ gals.

Quantity filled in one minute when the supply pipe and second escape pipe are open $= \frac{1}{100}$ of 1,000 gals. $= 10$ gals.

$\therefore$ Quantity emptied in one minute by first escape pipe
$= (5+10)$ gals.
$= 15$ gals.

Quantity emptied in one minute by the two escape pipes
$= (15+10)$ gals.
$= 25$ gals.

$\therefore$ The two escape pipes would empty the cistern in $(1{,}000 \div 25)$ minutes.
$= \underline{40 \text{ minutes.}}$

7. THYNER.—A, B, and C will trench a field in 12 days; B, C, and D in 14 days; C, D, and A in 15 days; and D, A, and B in 18 days. In what time will it be done (1) by all together, (2) by each separately?

A, B, C will trench in one day $\frac{1}{12}$,
B, C, D " " " $\frac{1}{14}$,
C, D, A " " " $\frac{1}{15}$,
D, A, B " " " $\frac{1}{18}$;
$\therefore$ (By addition)
3 (A, B, C, D) " " " $\frac{1}{12}+\frac{1}{14}+\frac{1}{15}+\frac{1}{18}$
$= \frac{105+90+84+70}{1260}$
$= \frac{349}{1260}$;
$\therefore$ A, B, C, D " " " $\frac{349}{1260} \div 3$
$= \frac{349}{3780}$.

D will trench in one day $\frac{349}{3780} - \frac{1}{12}$
$= \frac{349-315}{3780}$
$= \frac{34}{3780}$
$= \frac{17}{1890}$;

A " " " $\frac{349}{3780} - \frac{1}{14}$
$= \frac{349-270}{3780}$
$= \frac{79}{3780}$;

B " " " $\frac{349}{3780} - \frac{1}{15}$
$= \frac{349-252}{3780}$
$= \frac{97}{3780}$;

C " " " $\frac{349}{3780} - \frac{1}{18}$
$= \frac{349-210}{3780}$
$= \frac{139}{3780}$.

$\therefore$ All will trench the field in $\frac{3780}{349}$ days
$= 10\frac{290}{349}$ days.
A " " " $\frac{3780}{79}$ days
$= 47\frac{67}{79}$ days;
B " " " $\frac{3780}{97}$ days
$= 38\frac{94}{97}$ days;
C " " " $\frac{3780}{139}$ days
$= 27\frac{27}{139}$ days;
D " " " $\frac{1890}{17}$ days
$= \underline{111\frac{3}{17} \text{ days.}}$

8. H. ASH, Lechlade.—From a sum of money I paid first $\frac{1}{9}$ of $\frac{3}{7}$ of the whole; then $\frac{2}{3}$ of what was left; and after paying a fourth of the remainder I found I had only 5s. What money had I at first?

I first paid $\frac{1}{\cancel{9}_{\,3}}$ of $\frac{\cancel{3}}{7}$ or $\frac{1}{21}$ of my money;

$\therefore$ I had left $\frac{20}{21}$ of my money.

I then paid $\frac{2}{3}$ of what was left;

$\therefore$ I had remaining $\frac{1}{3}$ of what was left, or $\frac{1}{3}$ of $\frac{20}{21}$, or $\frac{20}{63}$ of my money.

I then paid $\frac{1}{4}$ of the remainder;

$\therefore$ I had left $\frac{3}{4}$ of the remainder, or $\frac{\cancel{3}}{\cancel{4}}$ of $\frac{\cancel{20}^{\,5}}{\cancel{63}_{\,21}}$, or $\frac{5}{21}$ of my money.

$\therefore \frac{5}{21}$ of the amount $= 5$s.
$\frac{1}{21}$ " " $= 1$s.
$\therefore$ The amount $= \underline{\text{a guinea.}}$

9. W. W. POTTER, Greens Norton.—A person invests £18,150 in the 3 per cents. at $90\frac{3}{4}$, and on their rising to 91, transfers it to the $3\frac{1}{2}$ per cents. at $97\frac{1}{2}$; what increase does he make thereby in his annual income?

£ £ £
$90\frac{3}{4}$: 18,150 :: 100 : Stock in first case
4 4
$\cancel{363}$ $\cancel{72{,}600}$
200
$=$ £20,000 Stock.

Income in first case $= 3\%$ on £20,000
$=$ £600.

£ £ £
$97\frac{1}{2}$: 91 :: $\cancel{20{,}000}$: Stock in second case
2 2 4,000
$\cancel{195}$ $\cancel{182}$
$\cancel{39}$ 14
3 4,000
$\boxed{56{,}000}$
£18,666 13s. 4d. Stock.

Income in second case $= 3\frac{1}{2}\%$ on £18,666 13s. 4d.

£18,666 13 4
$3\frac{1}{2}$
56,000 0 0
9,333 6 8
£653·33 6 8
20
s.6·66
12
d.8·$\cancel{00}$
£653 6s. 8d.

$\therefore$ Increase in income $=$ £653 6s. 8d. $-$ £600
$= \underline{\text{£53 6s. 8d.}}$

10. R. B., Northumberland.—If 2 boys and 1 man do a piece of work in 4 hours, and 2 men and 1 boy can do the same in three hours; find in what time (1) a man, (2) a boy, and (3) a man and a boy together, respectively, can do the same.

1 man and 2 boys can do the work in 4 hours,
and 2 men and 1 boy " " 3 "
$\therefore$ 1 man and 2 boys can do in one hour $\frac{1}{4}$ of the work,
and 2 men and 1 boy " " $\frac{1}{3}$ "
$\therefore$ (By addition)
3 men and 3 boys " " $\frac{1}{4}+\frac{1}{3}$ "
$= \frac{7}{12}$ "
$\therefore$ 1 man and 1 boy " " $\frac{7}{12} \div 3$ "
$= \frac{7}{36}$ "

1 man can do in 1 hour $\frac{1}{3} - \frac{7}{36}$ of the work,
$= \frac{5}{36}$ "
and 1 boy " " $\frac{1}{4} - \frac{7}{36}$ "
$= \frac{1}{18}$ "

(1) ∴ A man can do the work in $\frac{38}{5}$ hours
$= 7\frac{3}{5}$ hours.
(2) ∴ A boy „ „ 18 hours.
(3) ∴ A man and a boy „ $\frac{38}{7}$ hours
$= 5\frac{3}{7}$ hours.

11. J. HOWARD, Longton.—A, B, and C enter into partnership, with capitals which are as 1 : 2 : 3. In six months A withdraws one-half of his capital, but restores it after three months more. At the end of four months from the commencement, B withdraws one-third of his capital, and two months after, C adds twice as much as B withdrew. How should a profit of £658 10s. be divided at the end of a year? (Civil Service Exam., April, 1881.)

The capitals of A, B, C $= \frac{1}{6}, \frac{1}{3}, \frac{1}{2}$ of whole capital, respectively.
∴ (Proportionately)

$$\text{A's capital for the year} = \left(\tfrac{1}{6}\times 9\right)+\left(\tfrac{1}{12}\times 3\right) = \tfrac{3}{2}+\tfrac{1}{4} = \tfrac{7}{4}.$$

$$\text{B's „ „} = \left(\tfrac{1}{3}\times 4\right)+\left(\tfrac{2}{9}\times 8\right) = \tfrac{4}{3}+\tfrac{16}{9} = \tfrac{28}{9}.$$

$$\text{C's „ „} = \left(\tfrac{1}{2}\times 12\right)+\left(\tfrac{2}{9}\times 6\right) = 6+\tfrac{4}{3} = \tfrac{22}{3}.$$

$$\tfrac{7}{4}+\tfrac{28}{9}+\tfrac{22}{3} = \frac{63+112+264}{36} = \tfrac{439}{36}.$$

£658 10s. ÷ 439 = £1 10s.
∴ A's share = £1 10s. × 63 = £94 10s.;
B's „ = „ × 112 = £168;
C's „ = „ × 264 = £396.

12. ANDEFFARD.—I buy a field for a thousand pounds, for which I receive £30 a year rent, which I invest as soon as received at 4 per cent. compound interest. At the end of 3 years I sell it again for £1,030. What have I lost or gained by buying the field instead of investing the purchase-money on the same terms as I did the rent?

Rent + interest at end of 2nd year = £30 + 4% on £30 + £30
= £60 + £1·2
= £61·2.
„ „ „ „ 3rd „ = £61·2 + 4% on £61·2 + £30
= £91·2 + £2·448
= £93·648
∴ Total amount = £93·648 + £30
= £123·648.

Compound interest on £1,000 for 3 years at 4%:—
Amount at end of 1st year = £1,040.
„ „ 2nd „ = £1,040 + 4% on £1,040
= £1,040 + £41·6
= £1,081·6.
„ „ 3rd „ = £1,081·6 + 4% on £1,081·6
= £1,081·6 + £43·264
= £1,124·864.
∴ Compound interest = £124·864.
∴ Loss = £124·864 − £123·648
= £1·216
= £1 4s. $3\frac{21}{25}$d.

13. J. E. ROWLEY, Sedgley.—If goods bought in London at a guinea be exported to New York, at how many dollars should they be sold there, in order to cover all expenses; estimating the export charges to be $7\frac{1}{2}$ per cent., and the sale charges 5 per cent.; the course of exchange being 6 per cent. premium for bills on London? (A dollar is worth 4s. 6d. at par.)

$7\frac{1}{2}$ per cent. + 5 per cent. $= 12\frac{1}{2}\% = \frac{1}{8}$

$$\therefore \text{ Net amount in dollars } = \left(\frac{21}{1}\times\frac{\cancel{9}}{\cancel{8}_{4}}\times\frac{2}{\cancel{9}}\right) = \tfrac{21}{4}.$$

$$\therefore \text{ The goods must be sold for } \left(\frac{21}{\cancel{4}}\times\frac{\cancel{100}^{25}}{94}\right) \text{ dollars} = \tfrac{525}{94} \text{ dollars} = \underline{5 \text{ dollars } 58\tfrac{24}{47} \text{ cents.}}$$

14. H. T. KNOWLTON, Southampton.—A mixture of soda and potash, dissolved in 2,540 grains of water, took up 980 grains of aqueous sulphuric acid, and the weight of the compound solution was 4,285 grains. Find how much potash and how much soda the mixture contained, assuming that the aqueous sulphuric acid united with soda in the proportion of 49 grains to 32, and with potash in the proportion of 49 to 48. (*Hamblin Smith.*)

Quantity of potash and soda = {4,285 − (2,540 + 980)} grains
= (4,285 − 3,520) grains
= 765 grains.
$1\frac{1}{48}$ times potash + $1\frac{17}{32}$ times soda = 980 grains.
$\frac{1}{48}$ of potash + $\frac{1}{32}$ of soda = 20 grains.
Multiplying by 96, Twice potash + 3 times soda = (20 × 96) grs.
= 1,920 grs;
But, potash + soda = 765 grains.
∴ Twice potash + twice soda = 1,530 grains;
∴ (By subtraction),
Soda = 390 grains.
Potash = 375 grains.

15. DISCO.—A merchant sells 72 quarters of corn at a profit of 8 per cent., and 37 quarters at a profit of 12 per cent.; if he had sold the whole at a uniform profit of 10 per cent. he would have received £2 14s. 3d. more than he actually did; what was the price he paid for the corn? (*Barnard Smith.*)

Suppose the cost price were £100 per quarter,
Then the profit would have been £(72 × 8 + 37 × 12)—
= £(576 + 444)
= £1,020.
If sold at a uniform profit of 10 per cent. the profit would have been £{(72 + 37) × 10}
= £1,090.
Difference of profits = £1,090 − £1,020
= £70.

	£	£ s. d.		£		
∴	7~~0~~	: 2 14 3	::	10~~0~~	: cost price per qr.	
		10				
		27 2 6				
		£3 17 6 Ans.				

Algebra.

1. T. A. MUMMERY, Folkestone.—Find the exact value of the Compound Surd:

$$\sqrt[3]{\sqrt{108}+10} - \sqrt[3]{\sqrt{108}-10}.$$

$$\text{Assume } \sqrt[3]{\sqrt{108}+10} = \sqrt{x}+y,$$

$$\text{Then } \sqrt[3]{\sqrt{108}-10} = \sqrt{x}-y.$$

By multiplication, $\sqrt[3]{108-100} = x - y^2$
$\sqrt[3]{8} = x - y^2$
$x - y^2 = 2$
$\therefore x = y^2 + 2.$

Again, $\sqrt[3]{\sqrt{108}+10} = \sqrt{x}+y$

Cubing each side, $\sqrt{108}+10 = \sqrt{x^3} + 3xy + 3y^2\sqrt{x} + y^3$
$\therefore y^3 + 3xy = 10$
Substituting value of x, $y^3 + 3y(y^2+2) = 10$
$y^3 + 3y^3 + 6y = 10$
$4y^3 + 6y = 10.$

This equation is satisfied by $y = 1$; hence $x = 3$.

$$\therefore \sqrt[3]{\sqrt{108}+10} - \sqrt[3]{\sqrt{108}-10} = \sqrt{3}+1 - (\sqrt{3}-1) = \sqrt{3}+1 - \sqrt{3}+1 = \underline{2.\ \text{Ans.}}$$

2. J. FORREST, Guisbrough.—A man travels 5 miles in one day, 8 the next, 11 the next, increasing his journey regularly at the same rate; in how many days will he travel 735 miles?

This is a question in Arithmetical Progression, where a (first term) = 5, d (difference) = 3, s (sum) = 735, and n (No. of terms) is required.

$$s = \left\{2a + (n-1)d\right\}\frac{n}{2}$$

$$\therefore 735 = \left\{2\times 5 + (n-1)3\right\}\times\frac{n}{2}$$

$$= \left\{10 + 3n - 3\right\}\times\frac{n}{2}$$

$$= \left\{ 7 + 3n \right\} \times \frac{n}{2}$$

$$1470 = 7n + 3n^2$$

$$n^2 + \frac{7n}{3} = 490$$

$$n^2 + \frac{7n}{3} + (\tfrac{7}{6})^2 = 490 + \tfrac{49}{36}$$

$$= \tfrac{17689}{36}$$

$$n + \tfrac{7}{6} = \pm \tfrac{133}{6}$$

$$n = \pm \tfrac{133}{6} - \tfrac{7}{6}$$

$$\therefore n = 21 \text{ or } -23\tfrac{1}{3}.$$

It is apparent that the negative value is inapplicable, and therefore No. of days = 21.

3. H. TRIPLETON, Chesterfield.—Divide the number a into two such parts that the sum of the quotients obtained by dividing one part by m and the other by n may be equal to b.—*Hamblin Smith.*

Let x = one part,

Then $a - x$ = other part

$$\therefore \frac{x}{m} + \frac{a-x}{n} = b$$

$$nx + am - mx = bmn$$

$$nx - mx = bmn - am$$

$$(n-m)x = (bn-a)m$$

$$\therefore x = \frac{(bn-a)m}{n-m}$$

$$\text{or } \frac{(a-bn)m}{m-n} \text{ (one part).}$$

$$\text{Other part} = a - \frac{(a-bn)m}{m-n}$$

$$= \frac{am - an - am + bmn}{m-n}$$

$$= \frac{(bm-a)n}{m-n}.$$

4. J. TIMMS, Tronbridge.—If x^2+ax+b, and x^2+ex+d, have a common measure of the form $x+e$, show that $e = \dfrac{b-d}{a-e}$

If $x+e$ measure x^2+ax+b and x^2+ex+d, it will also measure their difference;

$$\therefore x+e \text{ will measure } x^2+ax+b-(x^2+ex+d),$$

$$\text{,, ,, ,, } ax-ex+b-d,$$

$$\text{,, ,, ,, } (a-e)x+b-d,$$

$$\text{,, ,, ,, } x+\frac{b-d}{a-e};$$

$$\therefore e = \frac{b-d}{a-e}.$$

Note.—Writing very good.

5. W. B., Kingston.—Transform 12345678 from the decimal to the duodecimal scale, and also to the scale of 7.

```
12 | 12,345,678
12 | 1,028,806... 6
12 | 85,733...10
12 | 7,144... 5
12 | 595.. 4
12 | 40... 7
       4... 1
```

$\therefore$ 12345678 in the decimal scale = 41745 t 6 in the duodecimal scale.

```
7 | 12,345,678
7 | 1,763,668 ..2
7 | 251,952...4
7 | 35,993...1
7 | 5,141...6
7 | 734...3
7 | 104...6
7 | 14...6
     2...0
```

$\therefore$ 12345678 in the decimal scale = 206636142 in the scale of seven.

JENISA.—If $\left(\frac{1}{x}+\frac{2}{y}+\frac{1}{z}\right)^2 = \frac{(x+2y+z)^2}{xy^2z}$, show that either $x = z$, or $y^2 = zx$. (*Science and Art*, May, 1881.)

$$\text{If } \left(\frac{1}{x}+\frac{2}{y}+\frac{1}{z}\right)^2 = \frac{(x+2y+z)^2}{xy^2z},$$

$$\text{Then } \left(\frac{yz+2xz+xy}{xyz}\right)^2 = \text{ ,,}$$

$$\text{Then } \frac{y^2z^2+4x^2z^2+x^2y^2+4xyz^2+2xy^2z+4x^2yz}{x^2y^2z^2}$$

$$= \frac{x^2+4y^2+z^2+4xy+2xz+4yz}{xy^2z},$$

$$\text{,, } y^2z^2+4x^2z^2+x^2y^2+4xyz^2+2xy^2z+4x^2yz$$

$$= x^3z+4xy^2z+xz^3+4x^2yz+2x^2z^2+4xyz^2,$$

$$\text{,, } y^2z^2+2x^2z^2+x^2y^2-2xy^2z-x^3z-xz^3 = 0,$$

$$\text{,, } y^2(z^2-2xz+x^2)-xz(x^2-2xz+z^2) = 0,$$

$$\text{,, } y^2(x-z)^2-xz(x-z)^2 = 0;$$

$$\therefore y^2 \text{ must equal } xz,$$

$$\text{or } (x-z)^2 \text{ ,, } 0;$$

$$\text{if } (x-z)^2 = 0, \text{ then } x = z.$$

$$\therefore x = z, \text{ or } y^2 = xz.$$

7. H. TAYLOR, Herne Hill.—Find the G.C.M. of

$8x^5+58x^4+23x^3+65x^2+17x+21$, and $x^5+6x^4-6x^3+6x^2+5x+84$.

$$\begin{array}{l}
x^5+6x^4-6x^3+6x^2+5x+84\,)\,8x^5+58x^4+23x^3+65x^2+17x+21\,(\,8\\
\qquad 8x^5+48x^4-48x^3+48x^2+40x+672\\
\qquad \overline{10x^4+71x^3+17x^2-23x-651}\\
10x^4+71x^3+17x^2-23x-651\,)\,10x^5+60x^4-60x^3+60x^2+50x+840\,(\,x+11\\
\qquad 10x^5+71x^4+17x^3-23x^2-651x\\
\qquad \overline{-11x^4-77x^3+83x^2+701x+840}\\
\qquad -10\\
\qquad \overline{110x^4+770x^3-830x^2-7,010x-8,400}\\
\qquad 110x^4+781x^3+187x^2-253x-7,161\\
\qquad \overline{-11x^3-1,017x^2-6,757x-1,239}\\
11x^3+1,017x^2+6,757x+1,239\,)\,110x^4+781x^3+187x^2-253x-7,161\,(\,10x+9,389\\
\qquad 110x^4+10,170x^3+67,570x^2+12,390x\\
\qquad \overline{-9,389x^3-67,383x^2-12,643x-7,161}\\
\qquad -11\\
\qquad \overline{103,279x^3+741,213x^2+139,073x+78,771}\\
\qquad 103,279x^3+9,548,613x^2+63,441,473x+11,632,971\\
-1800\;|\;\overline{-8,807,400x^2-63,302,400x-11,554,200}\\
\qquad 4,893x^2+35,168x+6,419
\end{array}$$

$$\text{Now, } 4,893x^2+35,168x+6,419 = (4,893x+917)(x+7)$$

The two quantities are divisible by $x+7$.

$\therefore$ G.C.M. $= x+7$.

8. ENQUIRER.—A and B walk over the same ground, going out one way and coming home the other, but they start in opposite directions. A walks $3\frac{3}{4}$ miles per hour, and B walks 4 miles per hour. A wants a quarter of a mile of being half way when he meets B. Required the length of the walk.

Let x = length of walk in miles,

Then $\frac{x}{2} - \frac{1}{4}$ = distance walked by A when they meet,

And $\frac{x}{2} + \frac{1}{4}$ = ,, ,, B ,, .

$$\therefore \left(\frac{x}{2}-\frac{1}{4}\right)\div 3\tfrac{3}{4}=\left(\frac{x}{2}+\frac{1}{4}\right)\div 4$$

$$\frac{2x-1}{\cancel{4}}\times\frac{\cancel{4}}{15}=\frac{2x+1}{4}\times\frac{1}{4}$$

$$\frac{2x-1}{15}=\frac{2x+1}{16}$$

$$32x-16=30x+15$$

$$32x-30x=15+16$$

$$2x=31$$

$$\therefore \underline{x=15\tfrac{1}{2}}.$$

$\therefore$ Length of walk $=$ $\underline{15\tfrac{1}{2}\text{ miles}}$.

9. N. A. B.—Solve—

$$\sqrt{9x+1}+\sqrt{4x-3}=13.$$

$$\sqrt{9x+1}+\sqrt{4x-3}=13$$

Squaring each side, $9x+1+2\sqrt{(9x+1)(4x-3)}+4x-3=169$

$$13x-2+2\sqrt{36x^2-23x-3}=169$$

Transposing, $2\sqrt{36x^2-23x-3}=171-13x$

Squaring each side, $4(36x^2-23x-3)=29{,}241-4{,}446x+169x^2$

$$144x^2-92x-12=29{,}241-4446x+169x^2$$

Transposing, $144x^2-169x^2-92x+4{,}446x=29{,}241+12$

$$-25x^2+4{,}354x=29{,}253$$

$$x^2-\frac{4{,}354x}{25}=-\frac{29{,}253}{25}$$

Completing the square ... $x^2-\frac{4{,}354x}{25}+\left(\frac{2{,}177}{25}\right)^2=\frac{4{,}739{,}329}{625}-\frac{29{,}253}{25}$

$$=\frac{4{,}739{,}329-731{,}325}{625}$$

$$=\frac{4{,}008{,}004}{625}$$

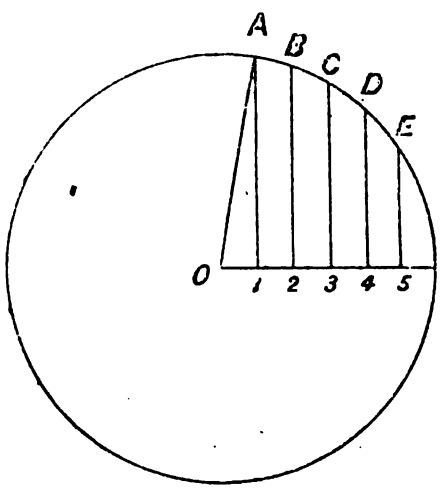
Extracting square root, $x-\frac{2{,}177}{25}=\pm\frac{2{,}002}{25}$

$$x=\pm\frac{2{,}002}{25}\times\frac{2{,}177}{25}$$

$$\therefore x=\frac{4{,}179}{25}\text{ or }\frac{175}{25}=167\tfrac{4}{25}\text{ or }7.$$

Mensuration.

1. X. L. C. R.—The radius of a circle is divided into six equal parts, and at the five points of division straight lines are drawn at right angles to the radius to meet the circumference. Find the lengths of these straight lines in inches to three decimal places, that of the radius being one foot.



Each of the divisions of the radius $=\frac{1}{6}$ of 1 foot $=$ 2 inches.

$A1=\sqrt{12^2-2^2}$ (i. 47) $=\sqrt{140}=11{\cdot}832\ldots$ in.

$B2=\sqrt{12^2-4^2}=\sqrt{128}=11{\cdot}313\ldots$ in.

$C3=\sqrt{12^2-6^2}=\sqrt{108}=10{\cdot}392\ldots$ in.

$D4=\sqrt{12^2-8^2}=\sqrt{80}=8{\cdot}944\ldots$ in.

$E5=\sqrt{12^2-10^2}=\sqrt{44}=6{\cdot}633\ldots$ in.

2. T. J. BEYNON, Saint Clears.—A ship's hold is 99 ft. long, 40 ft. broad, and 5 ft. deep; how many bales can be stowed in it each 3 ft. 6 in. long, 2 ft. 8 in. broad, and 2 ft. 6 in. deep, leaving a gangway of 4 ft. broad?

Note.—The gangway runs round the hold.

Cubical content of hold (without gangway)

$=\{(99-8)\times(40-8)\times 5\}$ cub. ft.

$=(91\times 32\times 5)$ cub. ft.

Cubical content of a bale $=(3\tfrac{1}{2}\times 2\tfrac{2}{3}\times 2\tfrac{1}{2})$ cub. ft.

$$\therefore \text{No. of bales}=91\times 32\times 5\div\frac{7}{\cancel{2}}\times\frac{\overset{2}{\cancel{8}}}{3}\times\frac{5}{\cancel{2}}$$

$$=\frac{\overset{13}{\cancel{91}}\times\overset{16}{\cancel{32}}\times\cancel{5}\times 3}{\cancel{7}\times\cancel{2}\times\cancel{5}}$$

$$=\underline{624}.$$

3. E. E. ATKINSON, Millom.—The sides of a rectangle are 16 and 24 feet; what breadth of border must be taken off all round that the remaining area may be 240 sq. ft.?

Let $x=$ breadth of border in feet;

Then $(24-2x)\times(16-2x)=$ area of remaining portion in sq. ft.

$$\therefore (24-2x)\times(16-2x)=240$$

$$384-80x+4x^2=240$$

$$4x^2-80x=240-384$$

$$=-144$$

$$x^2-20x=-36$$

Completing the square, $x^2-20x+(10)^2=-36+100$

$$=64$$

Extracting square root, $x-10=\pm 8$

$$x=\pm 8+10$$

$$\therefore \underline{x=18\text{ or }2.}$$

It is evident that 18 is inapplicable, therefore breadth of border $=$ 2 feet.

Note.—As this question is solved by Algebra, it should not have been placed under Mensuration in the Examination Paper.

4. T. HESLOP, Aldoth.—Two townships, A and B, having but one church, contribute to the repairs thereof in the proportion of 4 : 5. It so happens that the church has a conical wooden spire which wants the protection of a little paint. The circumference of the spire's base is 47 feet, and the altitude is 20 yards. Now the township A paints the upper part of the spire with black paint, and the township B paints the lower part with white paint. How far from the spire's base will be the boundary between the two colours, the price of white paint being twice as great as the price of black paint?

Part to be painted by A : part to be painted by B

:: 4×2 : 5×1

:: 8 : 5.

$\therefore$ Part to be painted by A $=\frac{8}{13}$,

" " " B $=\frac{5}{13}$.

Surface of spire $=$ (cirf. of base $\times$ slant height) $\div$ 2

Diameter of base $=$ 47ft. $\div$ 3·1416

$=$ 14·96ft.

Radius " $=$ 7·48 ft.

Slant height ... $=\sqrt{(7{\cdot}48)^2+60^2}$

$=\sqrt{55{\cdot}9504+3{,}600}$

$=\sqrt{3{,}655{\cdot}9504}$

$=$ 60·46ft.

$\therefore$ Surface of spire $=(47\times 60{\cdot}46\div 2)$ sq. ft.

$=$ 1,420·81 sq. ft.

$\therefore$ Surface to be painted by A $=\frac{8}{13}$ of 1,420·81 sq. feet.

$=$ 874·34 sq. ft.

and " " " B $=$ 546·47 sq. ft.

The surface to be painted by B is the surface of the frustrum of a cone, and equals the sum of the perimeters of the two ends multiplied by half the slant height.

Let $p=$ perimeter of the upper end of the frustrum, and let $h=$ the slant height of the frustrum.

$\therefore$ Surface to be painted by B $=(47+p)\times\frac{h}{2}$,

and " " " A $=p\times\frac{60{\cdot}46-h}{2}$.

$$\left.\begin{aligned}\therefore p\times\frac{60{\cdot}46-h}{2}&=874{\cdot}34\\(47+p)\times\frac{h}{2}&=546{\cdot}47\end{aligned}\right\}$$

$$\left.\begin{aligned}60{\cdot}46p-ph&=1{,}748{\cdot}68\\47h+ph&=1{,}092{\cdot}94\end{aligned}\right\}$$

(By addition)

$$60{\cdot}46\,p + 47h = 2{,}841{\cdot}62$$
$$\therefore p = \frac{2{,}847{\cdot}62 - 47\,h}{60{\cdot}46}$$
$$47\,h + \frac{h(2{,}841{\cdot}62 - 47h)}{60{\cdot}46} = 1{,}092{\cdot}94$$
$$2{,}841{\cdot}62h + 2{,}841{\cdot}62\,h - 47h^2 = 66{,}079{\cdot}1524$$
$$47\,h^2 - 5{,}683{\cdot}24\,h = -\ 66{,}079{\cdot}1524$$
$$h^2 - 120{\cdot}92\,h = -\ 1{,}405{\cdot}9394$$
$$h^2 - 120{\cdot}92h + (60{\cdot}46)^2 = 3{,}655{\cdot}4116 - 1{,}405{\cdot}9394$$
$$= 2{,}249{\cdot}4722$$
$$h - 60{\cdot}46 = \pm 47{\cdot}428$$
$$h = \pm 47{\cdot}428 + 60{\cdot}46$$
$$\therefore h = 107{\cdot}888 \text{ or } 13{\cdot}032.$$

∴ Boundary will be 13·032 ... feet (on the slant height) from the base.

General.

1. W. BOOKER, Sheffield.—Your solution to Query 43 is *incorrect.* You take for granted what has to be proved.

2. D. ROWE, Dunstable.—Your solution to Query 42 is *incorrect.* You say, 'Then the fourth side of the quadrilateral will be equal to the fourth line,' without any reason for this conclusion. The correct solution is entirely different to your method.

In your solution to Query 43 you do not prove that the perpendicular lines will fall as you have drawn them, and therefore it is *imperfect.* There is a simpler method of proof.

3. W. W., Stratford-on-Avon.—You must complete your apprenticeship to be qualified as an Ex-P.T.

4. GRAMMARIAN.—'Heavy'—Adj. qual., pos. deg., qual. the noun 'ivy-tod.'

5. G. N., Birkenhead.—Your easiest course is to get qualified as a Certificated Teacher in England. Your certificate would, we believe, stand you in good stead abroad.

6. A. D., Peckham.—The liberty of the English Press was established fully about 1780. The London printers were the first to claim the right of reporting Parliamentary debates.

7. LIBRETTO, Enfield.—We should advise you to apply to the undermentioned firms for their list of works such as you require:—
Messrs. Blackie and Son, Old Bailey, London, E.C.;
Messrs. Winsor and Newton; or to
Messrs. George Rowney and Co.

8. W. D. NICHOLAS.—The publishers of Carlyle's works are Chapman and Hall. The prices vary from 2s. a volume to £15 the set.

9. E. CROSS, Faversham.—A box, including its lid, is made of six equal square laminæ. Where is its centre of gravity when its lid is turned back through an angle of 180°? (*Science and Art*, 1881). Now, if the three laminæ forming the bottom, back, and lid be considered in the new position, it is clear that the centre of gravity of these three is the centre of the back, *i.e.*, the intersection of the diagonals.

Again, the centre of gravity of the two sides is the middle point of the line joining their centres of gravity; and the centre of the front is the intersection of its diagonals. Since these laminæ, the two sides and the front, are in the proportion of two to one, the centre of gravity of these three will be ⅓ of the distance between these centres of gravity from the front. If, now, these laminæ be taken, three and three, since their weights are equal, the centre of gravity of the whole will be midway between their centres of gravity. Now these centres of gravity are on the line joining the centres of the back and front, viz., at the centre of the back and at a point ½ of ⅓ or ⅙ from the front. Therefore, the distance between the centres of gravity is ⅚ of the whole line.

Wherefore, the centre of gravity of the whole is 5/12 of the distance between the centres of the back and front from the back.

Mathematics.—Mansford's Euclid, 1s.; Todhunter's Algebra, 2s. 6d.; and Trigonometry, 2s. 6d.

Mechanics.—Todhunter's Mechanics, 2s. 6d.; Galbraith and Houghton's Hydrostatics, 3s. 6d.

Physiography.—Huxley's Physiography, 7s. 6d.

10. EX P. T., Weston.—Order the syllabus through your bookseller, and then consult the nearest certificated teacher.

11. T. T. H., Sedgley.—Ross's *Elocution*, 3s. 6d. (Hughes); Taylor's *How to Compose*, 1s. (Hughes); Nicholl's *Composition*, 1s.

12. J. E. ROWLEY, Sedgley.—We should advise you to write to the following publishers for their lists:—
Messrs. Stewart and Co., Holborn Viaduct Steps, E.C.;
Messrs. Longmans, Paternoster Row, E.C.;
Messrs. G. Bell and Son, York Street, W.C.;
Messrs. Macmillan and Co., Bedford Street, W.C.; and to the Cambridge Warehouse, Paternoster Row, E.C.

13. J. W. C. A.—The word 'conynge' found in the account of a Spanish bull fight in Byron's 'Childe Harold,' Canto I., means in the sense in which it is there used 'skilful,' 'quick,' 'cunning.' It is evidently derived from the Latin *cogneo*, and may be found in the writers of the period of Renaissance, and also in the mediæval authors, especially in Chapman, Marlowe, &c.

14. R. PRYOR, Cornwall.—Thanks for correction.

15. URGENT.—Sutton's Manual 2s.

16. LINGUIST.—Your first two sentences are incorrectly stated. The third, translated, is 'Wales the land of song.'

17. COVENTRY.—The *correct* solution (similar to yours) appeared in our last issue.

18. C. WINSCOM, Cullingworth.—No one can say.

19. C. D. M'LEAN, Baillieston.—Thanks for pointing out the error in the *Scholarship Answers*; also for your high opinion of our journal.

20. PUPIL TEACHER, Worthing.—You will see your error from the following:—

Area of ABCD	...	= (120 × 80) sq. ft. = 9,600 sq. ft.
„ „ EFGH	...	= {(120 − 12) × (80 − 12)} sq. ft.
		= (108 × 68) sq. ft.
		= 7,344 sq. ft.
∴ Area of walk	...	= (9,600 − 7,344) sq. ft.
		= 2,256 sq. ft.
		= 250⅔ sq. yds.

21. W. S. ROBERTSON, Aberdeen.—There are no examinations for inspectors of schools. The 'Education Code' and the 'Syllabus for the Certificate Examination,' which may be obtained through any bookseller, will give the desired information for your second query.

22. H. WALKER, Bloxwich.—Thanks. You are right.

23. W. SEYMOUR, South Shields.—Your problem resolves into an equation, for which we can see no method of solution, although we have given a great deal of time to it. Sufficient data are not given.

24. P. P.—If two oblique systems have the same origin and axis of x, then

$$x = x' + y' \sin\frac{(\omega - \omega')}{\sin\omega},$$
$$y = y'\frac{\sin\omega'}{\sin\omega};$$

ω and ω' being the angles between the axes respectively.

If two oblique systems have the same origin, then

$$x\sin\omega = x'\sin(\omega - \alpha) + y'\sin(\omega - \beta),$$
$$y\sin\omega = x'\sin\alpha + y'\sin\beta;$$

where XOX′ = α, XOY = ω, XOY′ = β. (See Todhunter's *Conic Sections*, page 85.)

In the given case, $\alpha = 0$, and $\beta = \omega'$;

$$\therefore x\sin\omega = x'\sin\omega + y'\sin(\omega - \omega'),$$
$$y\sin\omega = y'\sin\omega';$$

that is, $$x = x' + y'\frac{(\sin\omega - \omega')}{\sin\omega},$$
$$y = y'\frac{\sin\omega'}{\sin\omega}.$$

25. EXCELSIOR.—(1) School Management (Currie's,); History (Curtis's, 5s. 6d.); Algebra (Todhunter's, 2s. 6d.); Mensuration (Elliot's, 2s.); Political Economy (Fawcett's,): Music (Sutton's, 2s.). (2) Yes.

26. J. W. W., Preston.—Euclid (Mansford's, 1s., and Exercises, 2s. 6d.; or Potts', 4s. 6d.); Algebra (Todhunter's, 2s. 6d.); Mensuration (Elliot's, 2s.); Geography (Cornwell's, 3s. 6d.); History (Curtis's, 5s. 6d.); School Management (Currie's,); French (Havet's Series).

27. C. WINSCOM, Cullingworth.—Williams's Geography of the Oceans (Philip and Son).

28. P. T., Gobanium.—Yes. The pupil teacher, having completed his apprenticeship, is free. It is well, however, in all such cases to remain, if possible, until the inspection of the school, to take the fifth (or last) year's papers, and to obtain H.M. Inspector's recommendation under Art. 60 of the Code.

29. LIBRETTO, Enfield.—Most books on harmony contain the nomenclature of intervals. These intervals are named according to the number of semitones they are apart, *together with* the alphabetical names of the respective notes between which the intervals are reckoned. It is needful to bear this latter in mind, as for example, F sharp and G flat are the same notes on the piano, but F sharp would be named an extreme sharp 4th from C (or, according to other nomenclature, a pluperfect or augmented 4th), whereas G flat would be termed an imperfect 5th from C. In the Chromatic scale the semitones are not counted inclusively, *e.g.*, from C to C sharp is one semitone, forming a minor 2nd; from C to D, two semitones, forming a major 2nd; from C to E flat, comprising three semitones, is a minor 3rd; from C to E, comprising four semitones, is a major 3rd. The intervals to which the term *perfect* is applied are the 4th, 5th, and 8th. Intervals that always require an accidental are termed Chromatic intervals, whereas Diatonic intervals may be formed in one part or other of every Diatonic scale without the aid of accidentals.

30. R. J. F.—The value of b to satisfy the *second* quantity can be easily obtained, but as this value does not satisfy the *first* quantity, you must have copied the question *incorrectly*. Please repeat your query, taking care to send it correctly.

31. E. M.—The query (No. 25) you refer to in the November part is incorrect. We calculated, as you say, 16oz. (instead of 12oz.) to the lb. Your solution by algebra is correct, but it can be easily solved by arithmetic, and if you desire the arithmetical solution it will be given.

32. L. MINER.—Show from the formulæ for sin B and sin $\frac{C}{2}$ that $B=\frac{C}{2}$, if $c^2=b(b+a)$.

$$\text{Sin } B=\frac{2}{ac}\sqrt{s(s-a)(s-b)(s-c)}$$
$$=\frac{\sqrt{2b^2c^2+2c^2a^2+2a^2b^2-a^4-b^4-c^4}}{2ac}$$

(If $c^2=b^2+ab$)

$$=\sqrt{\frac{2b^2(b^2+ab)+2a^2(b^2+ab)+2a^2b^2-a^4-b^4-(b^2+ab)^2}{4a^2c^2}}$$
$$=\sqrt{\frac{2b^4+2ab^3+2a^2b^2+2a^3b+2a^2b^2-a^4-b^4-b^4-2ab^3-a^2b^2}{4a^2(b^2+ab)}}$$
$$=\sqrt{\frac{3a^2b^2+2a^3b-a^4}{4a^2b(b+a)}}$$
$$=\sqrt{\frac{3b^2+2ab-a^2}{4b(b+a)}}$$
$$=\sqrt{\frac{3b-a}{4b}}.$$
$$\text{Sin }\frac{C}{2}=\sqrt{\frac{(s-a)(s-b)}{ab}}$$
$$=\sqrt{\frac{\frac{b+c-a}{2}\times\frac{c-b+a}{2}}{ab}}$$
$$=\sqrt{\frac{\{c+(b-a)\}\{c-(b-a)\}}{4ab}}$$
$$=\sqrt{\frac{c^2-(b-a)^2}{4ab}}$$

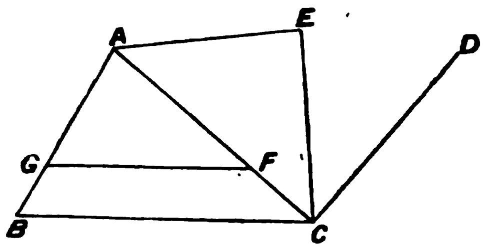
(If $c^2=b^2+ab$)

$$=\sqrt{\frac{b^2+ab-b^2+2ab-a^2}{4ab}}$$
$$=\sqrt{\frac{3ab-a^2}{4ab}}$$
$$=\sqrt{\frac{3b-a}{4b}}$$
$$\therefore B=\frac{C}{2}.$$

Geometry.

1. A SUBSCRIBER.—Bisect a triangle by a straight line drawn parallel to one of the sides.

Let ABC be the given triangle, and let it be required to bisect it by a straight line parallel to BC.



Construction.—At C draw CD at right angles to AC, and bisect the angle ACD by the straight line CE. At A make the angle CAE equal to the angle ACE. From AC cut off AF, equal to AE, and through F draw FG parallel to BC. Then GF shall bisect the triangle ABC.

Proof.—Similar triangles are to one another in the duplicate ratio of their homologous sides (vi. 19):

$\therefore \triangle AFG : \triangle ACB :: AF^2 : AC^2$.

But $AF^2 : AC^2$, as $AE^2 : AC^2$; and $AE^2 : AC^2 :: 1 : 2$ (i. 47).

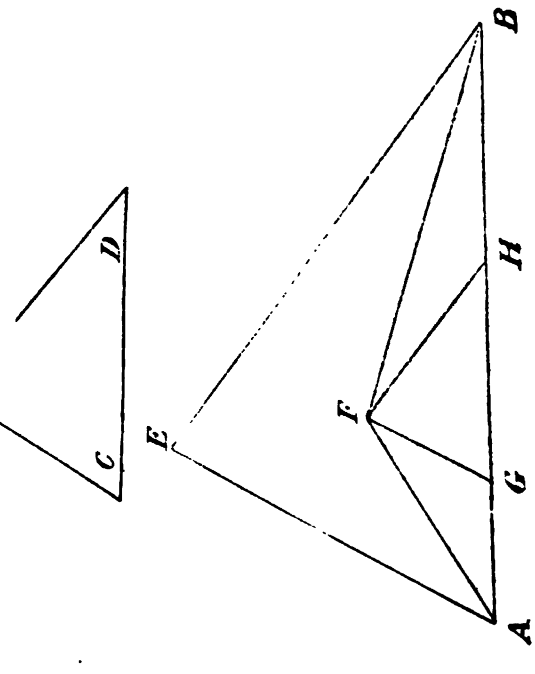
$\therefore \triangle AFG : \triangle ACB :: 1 : 2$.

Wherefore the straight line GF drawn parallel to BC bisects the triangle ABC.—Q.E.F.

2. E. AMES, Victoria Park.—Given two angles of a triangle and the perimeter to construct the triangle. (To be solved by means of the first twenty-six propositions.)

Let AB be the given perimeter, and C, D the given angles.

Construction.—At the point A make the angle BAE equal to C, and at B make the angle ABE equal to D. (I. 23.)



Bisect the angles BAE, ABE by the straight lines AF, BF, respectively. (I. 9.)

At the point F make the angle AFG equal to the angle FAG, and the angle BFH equal to the angle FBH.

Then GFH shall be the required triangle.

Proof.—Because the angle GFA = angle GAF (con.), side GF = side GA. (I. 6.)

Similarly it may be proved that HF = HB. ∴ Perimeter of triangle GFH = AB, the given perimeter.

Again, the angle FGH = angles GAF, AFG, (I. 32.) ∴ angle FGH = angle EAB = angle C.

Similarly it may be proved that angle FHG = angle D. ∴ the triangle GFH has two angles equal to C, D, respectively.

Note.—It will be noticed that the thirty-second proposition is employed in the proof. If the construction were not restricted to the first twenty-six propositions, it would be preferable to draw FG, FH parallel to EA, EB, respectively.

Training Colleges.

GENERAL EXAMINATION, 1881.

NOTICE ISSUED TO CANDIDATES AS TO COPYING AND CLANDESTINE ASSISTANCE.

Candidates who are detected—

(*a*) Introducing into the Examination Room, or having about them, any book or writing, whether any one uses it or not, from which answers may be copied;

(*b*) Applying, under any circumstances whatever, to other Candidates;

(*c*) Answering, under any circumstances whatever, applications from other Candidates;

(*d*) Copying, under any circumstances whatever, one from another; or,

(*e*) Conniving at any misconduct of this kind;

will be dismissed from the Examination—will forfeit any certificate which they may previously have obtained—and will be suspended, for a period not exceeding three years, from all recognition by the Committee of Council. The plea of accident, or forgetfulness, will not be received.

Candidates must leave the blotting paper, and paper for making rough drafts, which are supplied by the Inspector, on their desks at the end of each sitting, and must bring none other into the room. The use of blotting paper for rough drafts, or for any writing whatever, is strictly forbidden.

Whatever questions Candidates may have to ask, or remarks to make, during the Examination, must be addressed to the Inspector only.

All answers are to be written on the Examination Paper only.

The answer should (as far as possible) be *begun to be written* opposite to the questions to which they refer. If, in any case, Candidates cannot conveniently comply with this direction, they should head the answer, in a large heavy hand, thus:—'Section   Question   .'

If, in any case, a Candidate's writing be closer than the ruled lines, or confused and indistinct, the Paper will not be read.

The following was placed at the head of every paper:—

Before beginning your answers, fill up the following table.

You will do this although you may not answer any part of the paper, which, in that case, you will return to the Inspector, writing the words 'not attempted' in large letters below.

The Name of the Institution at which you are now being examined.	Your Name IN FULL, (the *Surname* first), and your Age on your last birthday.	Do you attend this Examination as— 1. A resident Student, and *of which year?* 2. A Teacher to be examined for a Certificate, and *from what School?*

FIRST YEAR.

MALE CANDIDATES.

Grammar and Composition.

Three hours allowed for this Paper.

Composition.

Every candidate *must* perform the exercise in Composition. Candidates are recommended not to take more than half-an-hour for this exercise.

Subjects for Composition.

(1) Mountain scenery.
Or (2) English sonnet writers.
Or (3) One of the incidents of the French Revolution commemorated in Wordsworth's Sonnets.
Or (4) The Lake Poets.

Grammar.

Every Candidate must do the parsing and analysis. Part of a question well answered will obtain marks.

SECTION I.

Parse the words italicised in the following passages:—

(*a*) There are *who* ask not *if* thine eye *be* on them.
(*b*) O *joy!* that in our embers is *something* that doth live.
That nature yet remembers *what* was so fugitive.
(*c*) But it will not be *long*, *ere this be thrown* aside.
(*d*) Yet despair
Touches me not, *though pensive* as a bird
Whose vernal *coverts* winter hath laid *bare*.

SECTION II.

Make a table for analysis of the following sentences:

(*a*) They a blissful course may hold
Even now, who, not unwisely bold,
Live in the spirit of this creed,
Yet seek Thy firm support according to their need.

(*b*) The homely nurse doth all she can
To make her foster-child, her inmate man,
Forget the glories he hath known,
And that imperial palace whence he came.

(*c*) What though the radiance which was once so bright
Be now for ever taken from my sight,
Though nothing can bring back the hour
Of splendour in the grass, of glory in the flower,
We will grieve not, rather find
Strength in what remains behind.

(*d*) We shall exult, if they who rule the land
Be men, who hold its many blessings dear,
Wise, upright, valiant; not a servile band,
Who are to judge of dangers which they fear,
And honour which they do not understand.

SECTION III.

(*Not more than four of these questions to be answered.*)

1. Write a brief analysis of the Ode to Duty.
2. Illustrate Wordsworth's love of Nature from his poems.
3. Give a short explanation, suitable for children, of the following passages:—
This public way streamed with the pomp of a too credulous day.
Vanguard of liberty, ye men of Kent!
She must espouse the everlasting sea.
England is a fen of stagnant water.
Plain living and high thinking are no more.
4. To what events is allusion made in the following passages?
Once did she hold the gorgeous East in fee.
Toussaint, the most unhappy man of men.
Thou, Liberty, from thine Alpine holds at length are driven.
Another mighty Empire overthrown.
Who, like Montrose, make loyalty your pride.
5. Derive *paramount*, *ledger*, *phrensy*, *tyrant*, *worldling*.
6. Give the force of the prefix in *apparel*, *dialogue*, *sympathy*, *forget*, *cataract*, *adverse*, *misgiving*.

SCHOOL MANAGEMENT.

Three hours allowed for this Paper.

Question 1A must be answered, and Question 1B must be omitted, by Students who leave the Training College to take charge of Schools after this Examination, and by Acting Teachers.

Question 1A must be omitted, and Question 1B must be answered, by all Students who are remaining in the Training College.

Not more than *nine* other questions may be answered.

Answer briefly the following questions:—

1A. (*a*) What are the advantages of a separate classification in Arithmetic?

(*b*) Why should caning on the hand be absolutely prohibited in schools?

(*c*) Why do younger boys require shorter lessons than older boys?

(*d*) In what respects is long standing in class prejudicial?

(*e*) What data are required for calculating the average yearly attendance?

(*f*) The number of failures in Reading is 17; in Writing, 19; in Arithmetic, 23; the percentage of passes is $86\frac{2}{3}$; find the number of children presented for examination.

1B. Write full notes of a lesson on—

(*a*) The benefits of life insurance.

Or (*b*) A course of gymnastic exercises.

Or (*c*) The laws of gases which determine efficient systems of ventilating drains.

Or (*d*) The physical laws involved in the construction of a common pump.

2. Explain briefly the Phonic and Look-and-Say methods of teaching to read; and give examples of words which are more easily taught by each of these methods.

3. How would you distribute three-quarters of an hour to be employed in a reading lessonn on a passage of poetry from an *unknown* author? Illustrate by a short passage, containing not less than twenty lines, taken from the author selected for Grammar in the present syllabus.

4. Give brief explanations, suitable to children, of the words italicised in the following passages, with derivations (where you can):—

> His hand still *strained* the broken *brand;*
> His arm was *smeared* with blood and sand:
> Dragged from among the horses' feet,
> With *dinted* shield and helmet beat,
> The *falcon-crest* and *plumage* gone,
> Can that be *haughty* Marmion?
> Young Blount his armour did *unlace*,
> And gazing in his *ghastly* face,
> Said, by *Saint George*, he's gone!

5. Show that reproduction in exercise-books of oral lessons, or of short tales read aloud, is one of the best methods of teaching Composition to young children.

6. What rules would you give for the heights and junctions of the letters in the word "Emphasized" written in large hand? Write the word according to your rules.

7. Write out rules to be followed in the spelling of those parts of the following words which present difficulties to beginners:—conceit, receipt, colour, achieve, forego, moveable, wagon.

8. Point out the advantages and disadvantages of teaching Simple and Compound Addition together, before proceeding to other rules.

9. Write out fully the various steps to be followed in proving the rule for converting vulgar fractions into terminating decimals, and state under what conditions this is possible.

10. Write out clearly and concisely the difference between true discount and banker's discount, and give an explanation of the constant fluctuations of consols.

11. State the principal natural laws involved in a lesson on 'Wind,' and describe any simple experiments or illustrations by which you would propose to illustrate those laws.

12. Explain the difference in the nature and purpose of questions employed at the beginning, during the course, and at the close, of an oral lesson; illustrate by a lesson on 'Coffee.'

13. Show that oral teaching in most subjects requires to be supplemented by text-books and exercise-books; and name any subjects that do not require such aids, giving your reasons.

14. Describe the arrangement of windows, doors, desks, and other apparatus in a class-room designed for giving oral lessons to sixty children.

15. Explain why, in a text-book, the definition generally precedes, and in an oral lesson generally follows, the matter required for a full explanation.

British History.

Three hours allowed for this Paper.

Candidates are not to answer more than *eight* questions.

1. Write a life of St. Dunstan; and explain the terms secular and regular clergy.

2. Explain briefly the purposes for which Doomsday Book was compiled.

3. Write an account of the state of government of the country between the mouths of the Humber and Forth in the ninth century.

4. Sketch briefly the state of affairs in Scotland which gave cause for the interference of Edward I.

5. Give some account of Froissart, and of the period of history that is covered by his chronicles.

6. Explain briefly the origin of the Hundred Years' War between France and England; and enumerate, with dates, the chief events of that war.

7. Show that the reigns of the Lancastrian kings were favourable to the growth of liberty.

8. What Scottish kings were contemporary with Henry IV., Edward IV., and Henry VIII.? Write a brief life of one of those monarchs.

9. Make a table showing the grandchildren and great-grandchildren of Henry VII.

10. Discuss the justice of Elizabeth's behaviour towards Mary Queen of Scots.

11. What were the chief points at issue between Charles I. and the Long Parliament? On what points were negotiations finally broken off at the beginning of the Civil War?

12. Describe the position of the following battle-fields:—Blenheim, Dettingen, and Vittoria; name the leaders on both sides, and the result of the battle in each case.

13. Write a brief life of the younger Pitt.

14. Give some account of the Orders in Council. Explain the purposes for which they were issued, and the circumstances of their repeal.

15. Enumerate the chief events of the years 1814-15.

16. Describe the state of affairs in Greece which occasioned the Battle of Navarino; name the nations which took part in that battle, and its results.

17. What were the provisions of the Act passed for the Emancipation of slaves in 1833.

18. Explain the causes of the Crimean War, and give a brief account of the Siege of Sebastopol.

Geography.

Three hours allowed for this Paper.

Candidates must draw one of the maps in Qnestion I., and must not answer more than *eight* other questions.

1. Draw a map of (*a*) Great Britain (showing the principal river basins); *or* (*b*) the Indian Ocean; *or* (*c*) the coast line of Africa (north of the Equator), showing the boundaries of the states or colonies bordering upon the sea.

N.B.—The map should be drawn on a scale sufficient to occupy all the blank space available. If the candidate put in and correctly number the lines of latitude and longitude it will add to the value of the exercise.

Places must not be indicated by letters or figures, referring to a list of names at the side, but *the names themselves must be inserted in the map.*

2. Compare the climate of London with that of New York and of St. Petersburg, and account generally for these differences.

3. By what trunk railways are the towns of Exeter, Shrewsbury, Dover, and Yarmouth connected with London? Give a brief description of the route traversed by one of these.

4. Show that the coast of Scotland is large in extent, but in a great measure unfit for commerce. Name the chief localities of the fishing industry of Scotland.

5. Enumerate the principal districts north of the Humber and Mersey remarkable for their natural wealth in minerals.

6. Describe briefly the positions of Upsala, Amsterdam, Lyons, Ischia, Bucharest, Moscow, Constance, and Salzburg.

7. Describe in words the courses of the Po and the Vistula, and name any incidents in history connected with those streams.

8. Enumerate the chief vegetable productions of India, and the climate required by each; name the districts chiefly devoted to their cultivation.

9. Describe the physical features of China Proper. Give a brief account of the Great Wall of China.

10. Give some account of the Lakes of Africa, and of the general directions of the rivers which rise in those lakes.

11. Classify as New England, Southern, Pacific, or Central States—Louisiana, Oregon, Iowa, Maine, California, Connecticut, Alabama, Illinois, and Michigan; and give a brief account of one of those states.

12. Enumerate the principal imports into Great Britain from Hong-Kong, Chicago, Wellington, Bombay, Jamaica, and Buenos Ayres.

13. Enumerate the rivers of South America which flow into the Atlantic Ocean, the principal towns on the banks, and the states through which they flow.

14. Name the principal groups of islands in the Malay Archipelago, and their chief articles of export; and give some account of the native races.

Euclid.

Two hours and a-half allowed for this Paper.

Candidates are not allowed to answer more than *eight* questions. Capital letters, not numbers, must be used in the diagrams. The only signs allowed are + and =. The square on AB may be written "sq. on AB," and the rectangle contained by AB and CD, "rect. AB. CD."; other abbreviations, if employed, must not be ambiguous.

1. Show that part of Euclid's definition of a square is not required. Write out the postulates. Write out all the cases of equality of triangles which are given in the First Book of Euclid.

2. If two triangles have two sides of the one equal to two sides of the other, each to each, and have also the angles contained by these sides equal to one another, they shall also have their bases or third sides equal. Two triangles ABC and DCB, equal in all respects, are on the same side of the base BC; if AD be joined, the triangle ABD is equal to the triangle DCA in all respects.

3. If a side of a triangle be produced, the exterior angle shall be greater than either of the interior opposite angles. If one of the angles of a triangle be a right angle, the three exterior angles of a triangle will be together greater than three right angles.

4. If two triangles have two angles of the one equal to two angles of the other, each to each, and the sides opposite to one of the equal angles in each equal, the third angle of the one shall be equal to the third angle of the other.

Draw a figure showing that two triangles that have two sides and an angle equal in each may have no other parts equal.

5. Every parallelogram is bisected by its diameter.

Construct a parallelogram of given area with diagonals of given length.

6. Triangles on equal bases and between equal parallels are equal to one another.

If two equal triangles stand upon equal bases, and have also another side of each equal, the triangles will have all or none of their other parts equal.

7. To a given straight line to apply a parallelogram which shall be equal to a given triangle, and have one of its angles equal to a given rectilineal angle.

On the diameter of a square construct a parallelogram equal to the square, and having one of its angles equal to one-fourth of a right angle.

8. If the square described on one of the sides of a triangle be equal to the squares described on the other two sides of it, the angle contained by those sides is a right angle.

If one of the angles of a rhombus be double of the other, show that the square on the longer diameter is three times as great as the square on a side.

9. Which of the propositions of the Second Book of Euclid may be represented algebraically by the formula $\overline{a+x}^2=a^2+ax+x^2$?

Draw the figure required for the proposition.

10. To describe a square that shall be equal to a given rectilineal figure.

If one of the sides of a rectangle be four times as great as the other, find the side of the square equal to the given rectangle.

11. Show that the lines bisecting the angles of a triangle meet in a point.

12. The figure formed by joining the points of bisection of the sides of a quadrilateral, taken in order, is equal to one half of the whole figure.

Arithmetic.

Two hours and a half allowed for this Paper.

Candidates are not permitted to answer more than *ten* questions.

The *solution* must be given at such length as to be intelligible to the Examiner, otherwise the answer will be considered of no value.

1. A clock is set right at 2 p.m. on Monday, December 12th; and at 6 p.m. on Friday, December 16th, it is 5 minutes slow. How much has it lost per hour?

2. A block of stone, weighing 15 tons, is composed of 4 substances, whose bulks are in the relation of 15, 13, 9, 7; while the weights of a unit of their bulks are as 6, 7, 11, 8. What is the weight of each substance in the block?

3. What will be the cost of the bricks for a wall 5 feet high, $22\frac{1}{2}$ inches thick, and 35 yards long, at 15s. per 1,000, each brick being 9 inches long, $4\frac{1}{2}$ inches wide, and 3 inches thick?

4. If a cubic inch of silver be worth £1 12s. 6[illegible]d., find the value of a circular piece of money, whose diameter is $1\frac{1}{4}$ inch, and its thickness $\frac{1}{16}$ inch, taking the ratio of the circumference of a circle to its diameter as 22 to 7.

5. Arrange the fractions :—

[illegible]

in their order of magnitude.

6. Explain the use of the Greatest Common Measure of two numbers or quantities; and reduce the fraction [illegible] to its simplest form.

7. Find the value of—

$$£1\ 1s.\ 1\tfrac{1}{2}d. \times \frac{[\text{illegible}]}{[\text{illegible}]} \times \frac{[\text{illegible}]}{[\text{illegible}]}$$

8. A grocer bought 59 cwt. 3 qrs. 4 lbs. of sugar at £1 5s. 8d. per cwt.; of this 1 cwt. 20 lbs. was unsaleable. With what profit did he sell the remainder at $3\frac{1}{2}$ per lb.?

9. If an iron casting, that weighs 5 tons 11 cwt. 9 lbs., cost £142 11s. $0\frac{3}{4}$d., what will be the weight at the same rate of a casting that costs £54 16s. $6\frac{3}{4}$d.?

10. £150 of a man's income was exempt from income-tax: and, after deducting the tax at 5d. in the £1 on the remainder from his whole income, he had £884 7s. 6d. left. What was his income?

11. Explain the term 'recurring decimal;' find the recurring decimals that represent $\frac{4}{7}$, $\frac{1}{3}$, $\frac{5}{11}$, $\frac{1}{15}$, and add the results.

12. If the weights of the same bulks of mercury and glycerine be as 11 to 1, what will be the height of a glycerine barometer when the mercurial barometer stands at 29·45 inches?

13. What sum of money put out at $3\frac{1}{2}$ per cent. simple interest for $5\frac{1}{2}$ years will amount to £476 10s. $0\frac{3}{4}$d.?

14. A. invests £4,625 in railway stock at 125, B. invests £4,920 in another at 120; A. receives an annual dividend at the rate of $4\frac{1}{2}$ per cent., and receives £3 10s. more than B.; at what rate was the annual dividend paid to B. calculated?

15. A person sells out £3,162 10s. in 3 per cent. stock at $97\frac{1}{4}$; and buys in Bank Stock at $287\frac{1}{4}$, paying his broker 2s. 6d. on each £100 of stock sold or bought. He receives on his investment an April dividend of 4 per cent., and another in October of 5 per cent. How far is his income effected by the Exchange?

Algebra and Mensuration.

Three hours allowed for this Paper.

Candidates are not permitted to answer more than *nine* questions in Algebra nor more than *three* in Mensuration.

Algebra.

1. What is the meaning of $(a-b)$ where b is greater than a? How would you detect at first sight the errors in the statement $(x+a)(x+b)(x+c) = x^3 + (a+b)x + (ab+bc)x + abc$ without any previous multiplication or knowledge of the result?

2. Show that $(x+1)(x+2)(x+3)(x+4)+1 = (x^2 + 5x + 5)^2$.

3. Prove the rule for finding the G.C.M. of two quantities; and find the G.C.M. of $6x^3 - 19x^2 + 37x - 18$ and $9x^3 - 27x^2 + 26x - 8$.

4. Divide $x^2 - y$ by $x^{\frac{1}{2}} - y^{\frac{1}{4}}$ and find the value of the quotient, when $x = 49$, $y = 625$.

5. Reduce to lowest terms—

$$\frac{x^2 - x - 6}{x^2 - x - 20} \times \frac{x^2 - 12x + 35}{x^2 + 10x + 16} \times \frac{x^2 + 12x + 32}{x^2 + 2x - 15}$$

6. Find the L.C.M. of $x^2 - a^2$, $x^3 - a^3$, $x^2 - ax + a^2$, $x^3 + a^3$, $x^2 + ax + x^2$.
7. Find the fourth root of $x^4 + 12x^3 + 54x^2 + 108x + 81$.
8. Prove that a quadratic equation can have only two roots; and form the equation whose roots are 7 and -3.
9. Solve the equations—(1) $x^2 - 2x - 15 = 0$. (2) $(x - 1)(x - 2)(x - 3) + 6 = 0$.
10. Solve the equations $x^3 - y^3 = 26$, $x - y = 2$.
11. Eliminate x from the equations $x^2 + ax + b = 0$. $x^2 + cx + d = 0$.
12. If $a : b :: b : c$;

Show that $\dfrac{ma^3 + b^3}{mb^3 + c^3} = \dfrac{a^3 + nb^3}{b^3 + nc^3}$

13. A, G, H are the arithmetical, geometrical, and harmonical means between a and b; show that $AH = G^2$ Ex. $a = 20$, $b = 35$.
14. A. is $1\frac{1}{2}$ inches taller than B., B. is $2\frac{1}{2}$ inches taller than C.; at the end of two years each has grown two inches, and the sum of their heights at that time is to the sum of their heights two years before in the ratio 317 : 305; find their original heights.
15. A man and his family consume 5 loves of bread weekly; if his wages were raised one-fortieth and the price of bread were raised one quarter, he would gain twopence weekly; but if his wages were diminished one-twentieth and the price of bread fell one-third, he would lose tenpence; find his weekly wages and the price of each loaf of bread.

Mensuration.

(The answers need not be carried beyond two places of decimals.)

1. The depth of the annual rainfall A is $22\frac{1}{2}$ inches; find the number of tons of water which fall annually upon a rectangular space of 24 chains long and 15 chains broad, a cubic foot of water weighing 1,000 oz.
2. A chain measure is short by one inch in each chain, find in acres the error committed in estimating the area of a rectangle 511 yards long, and 365 yards broad.
3. The areas of a hexagon and of the equilateral triangle formed by joining alternate angles of the hexagon are together equal to $\sqrt{3888}$ feet; find a side of the hexagon.
4. A quadrilateral is formed by two isosceles triangles on opposite sides of a common base; show that the area of the parallelogram formed by joining the bisections of the sides of the quadrilateral taken in order is invariable, if the distance between the vertices of the triangles are invariable.

SECOND YEAR.

MALE CANDIDATES.

SHAKESPEARE'S *Coriolanus* and BACON'S *Essays*.

Three hours allowed for this Paper.

Composition.

Every candidate *must* perform the exercise in composition. It is recommended that not more than *half an hour* be devoted to this exercise.

Write in plain prose a short essay on:—(1.) The Patrician Order at Rome. *Or* (2.) The date of the play of Coriolanus from internal evidence. *Or* (3.) The revolution in scientific method, introduced by Bacon. *Or* (4.) The progress of some branch of science in the present century.

Grammar.

Candidates may answer the whole of Section I., and *four* in each of the other subjects.

Marks will be obtained by answering well part of a question.

SECTION I.

Write in simple prose, and without any more amplifications than the sense requires, the following passages:—

(*a*) I have been
The book of his good acts, whence men have read
His fame unparallel'd, haply amplified;
For I have ever verified my friends,
Of whom he's chief, with all the size that verity
Would without lapsing suffer; nay, sometimes,
Like to a bowl upon a subtle ground,
I have tumbled past the throw, and in his praise
Have almost stamped the leasing.

(*b*) His sword, death's stamp
Where it did mark, it took; from face to foot
He was a thing of blood, whose every motion
Was timed with dying cries. Alone he entered
The mortal gate of the city, which he painted
With shunless destiny, aidless came off
And with a sudden reinforcement struck
Corioli like a planet. Now all's his:
When by and by the din of war 'gan pierce
His ready sense: then straight his doubled spirit
Requickened what in flesh was fatigate.

(*c*) To apply oneself to others is good, so it be with demonstration, that a man doth it upon regard and not upon facility. It is a good precept generally in seconding another, yet to add somewhat of one's own; as if you will grant his opinion, let it be with some distinction; if you will follow his motions, let it be with conditions; if you allow his counsel, let it be with alleging farther reasons. Men had need beware how they be too perfect in compliments, for be they never so sufficient otherwise, their enviers will be sure to give them that attribute to the disadvantage of their greater virtues. It is loss also in business to be too full of respects or to be too curious in observing times and opportunities.

SECTION II.

1. Derive *verdict*, *alarum*, *prerogative*, *century*, *sithence*, *caparison*, *godden*, *malkin*, *jot*, *anon*.
2. Comment on the following:—I cannot speak him home, the cranks and offices of men, him vice that was your garland, he will not spare to gird the gods, his brows bound with oak, irons of a doit, the hospitable canon, Amazonian chin, well might they tent themselves with death.
3. Explain the metaphors in—that's off, this had touched his spirit, the cockle of rebellion, vail your ignorance, this is clean kam, bolted language, friends of noble touch, lots to blanks, a jack guardant, standing every flaw.
4. In what sense, differing from their modern usage, were the following words employed by Shakespeare—*virtue*, *censure*, *sensible*, *humours*, *complexion*, *affect*, *temperance*, *fond*, *particular*, *judicious*.
5. Explain the prefix in *an-hungry*, *bestrid*, *allow*, *perfidious*, *avoid*, *surname*, *entertain*, *surcease*, *sedition*, *malign*.
6. Explain the peculiarities in the grammatical construction of

Whose course will on the way it takes.
Rather than fool it so.
My armed knees who bowed but in my stirrup's bend.

7. Write a brief summary of Volumnia's pleading with her son for Rome.

SECTION III.

1. Write a brief abstract of the Essay on Studies.
2. Give Bacon's rules for the regimen of health.
3. Illustrate from history the truth of the following sayings—

Plantations are amongst ancient primitive and heroical works.

Upon the breaking of a great empire you may be sure to have wars.

The lower and weaker faction is the stronger in conjunction.

4. Explain briefly the following aphorisms—

Ordinary expenses ought to be limited by a man's estate. Suspicions among thoughts are like bats among birds.

5. Give the modern form of the words disadvantageable, ambassage, spials, avoidances, discontent (adj.), theologues, passable; and account for the disuse of these forms.
6. Give the meaning in the time of Bacon of advancement, composition, merely, to attend arms, estate, circumstance, obnoxious, bravery, decent, undertaker, deprave.
7. Distinguish jus suffragii and jus commercii, jus dicere and jus dare, logic and rhetoric, honour and reputation, custom and habit.
8. Translate with brief explanations—octogesimus octavus mirabilius, annus, abeunt studia in mores, Cæsarem portas et fortunas ejus.
9. Complete the following—'Men's thoughts are much according to——————; their discourses and speeches according to——————; but their deeds——————.'

'Reading maketh a full man, etc.'

School Management.

Two hours allowed for this Paper.

The Questions on pages 1 and 4 must not be omitted by any candidate.

Not more than *seven* other questions may be answered.

1. Answer briefly the following questions:—

(*a*) What are the advantages of a separate classification in arithmetic?

(b) Why should caning on the hand be absolutely prohibited in schools?

(c) Why do younger boys require shorter lessons than older boys?

(d) In what respects is long standing in class prejudicial?

(e) What data are required for calculating the average daily attendance throughout the year?

(f) The number of failures to pass in reading is 17, in writing 19, in arithmetic 23; the percentage of passes is 86⅔; what is the number of children presented for examination?

2. Make out that part of a week's time-table for an upper class which would include the lessons given in Arithmetic, Geography, and Grammar, and give reasons for the length of lessons and the times selected.

3. Apply to a lesson on Moods the principle that in Grammar no rule should be given without the inquiry which gives rise to the rule.

4. Show and illustrate, by a sketch map of the neighbourhood of some school, the advantages to be gained in the early stages of Geography by the study of an accurate plan.

5. Before committing a passage of poetry to memory what preparation is required for a senior class? Apply your method to a passage from the author you have been studying for Grammar according to the present syllabus.

6. With which of the sciences is Physical Geography closely connected? Illustrate this connection in the case of one of the sciences you have named.

7. Give examples from some language you have studied to show that the study of a foreign language increases a teacher's knowledge of his mother tongue?

8. Show the peculiar value of object lessons in increasing a child's stock of words, and illustrate your statement by the new terms required for an object lesson on 'Iron.'

9. Give a passage from the author you have been studying for Grammar to exemplify the difficulty of paraphrasing an involved passage in exact synonyms.

10. What precautions does Locke suggest to preserve children from unreasonable timorousness?

11. Illustrate by a brief lesson on 'Honesty' the most effectual methods of enforcing moral truths on young children.

12. Detail some of the methods by which a healthy appetite for knowledge may be encouraged in children.

13. What rules would you lay down for checking the first signs of deceitfulness in the character of a child?

14. Write an essay on—

(a) The denying ourselves the satisfaction of our own desires where reason does not authorise them.

Or (b) The allowing liberty to children in their recreations.

Or (c) The use and abuse of bodily chastisement.

British History.

Two hours and a half allowed for this Paper.

Candidates are not permitted to answer more than eight questions.

1. Relate the circumstances which gave rise to the Septennial Act, and discuss the assertion that the passing of that Act was an usurpation of the rights of the people.

2. Name the chief financial proposals of Walpole, and explain how they were frustrated in the House of Commons.

3. Sketch briefly the campaign of Charles Edward in 1745.

4. Write a brief life of some distinguished Scotchman who flourished in the 18th century.

5. Give some account of the policy and measures of the twelve years' ministry of Lord North.

6. Describe the position of Bunker's Hill, Fontenoy, and Salamanca; and state the leaders on both sides, and the result of the battle in each case.

7. Relate the circumstances which gave rise to the Gordon Riots, and describe the behaviour of the authorities and of the king on that occasion.

8. Write a short account of the career of Hyder Ali.

9. Describe the influence of the French Revolution upon the state of English parties.

10. Give some account of Pitt's policy towards Ireland.

11. Describe the state of Ireland in the years 1795-96.

12. Sketch briefly the campaign in Spain which closed with the battle of Corunna.

13. Describe the condition of British Trade in the years 1817-18; and relate the circumstances of the unhappy affray known as the 'Manchester Massacre.'

14. Describe briefly the chief anomalies rectified by the passing of the first Reform Bill.

15. Name the chief abuses which gave rise to the enactment of the New Poor Law in 1834; and describe generally how relief of the poor is administered under its provisions.

(*To be continued.*)

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